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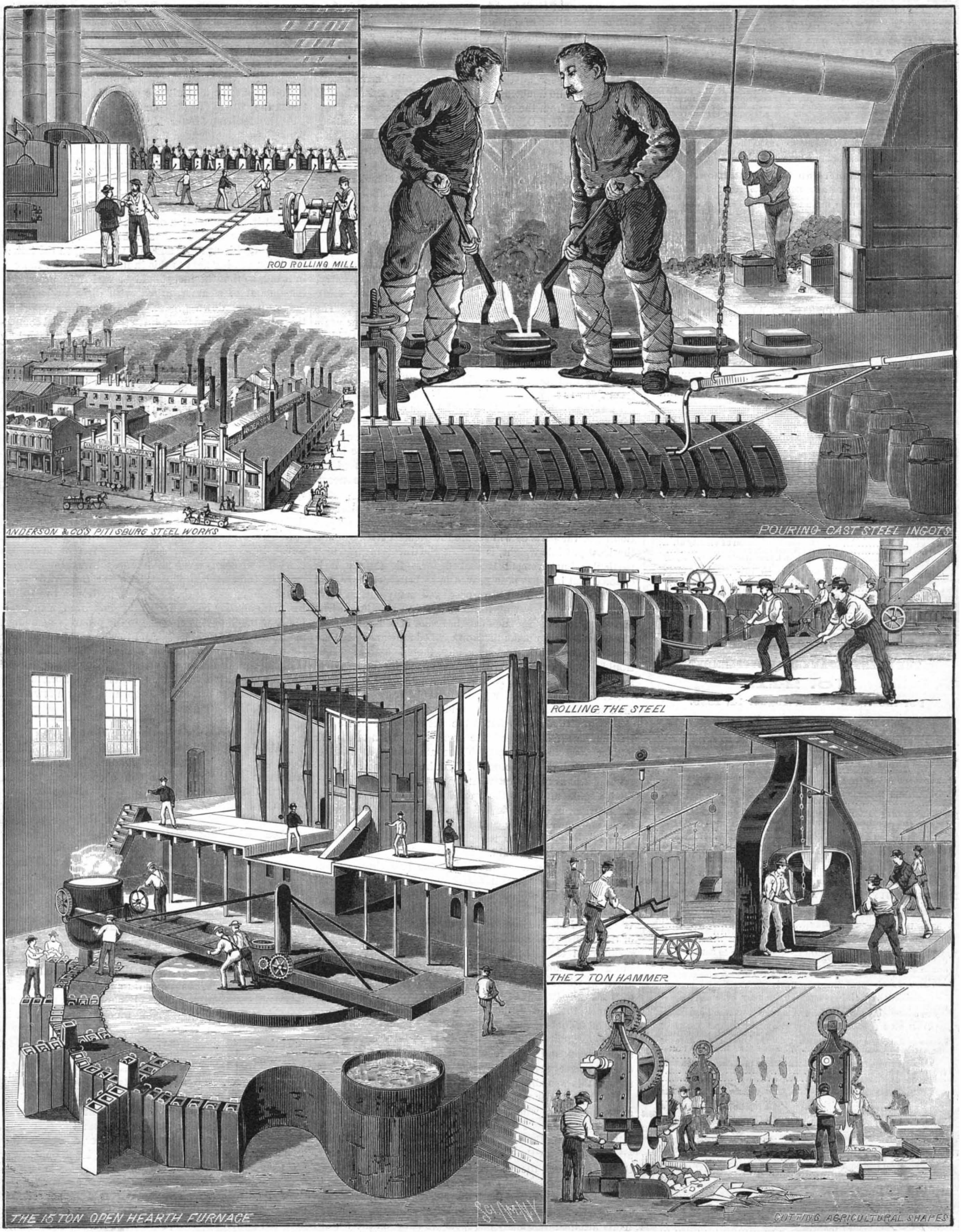
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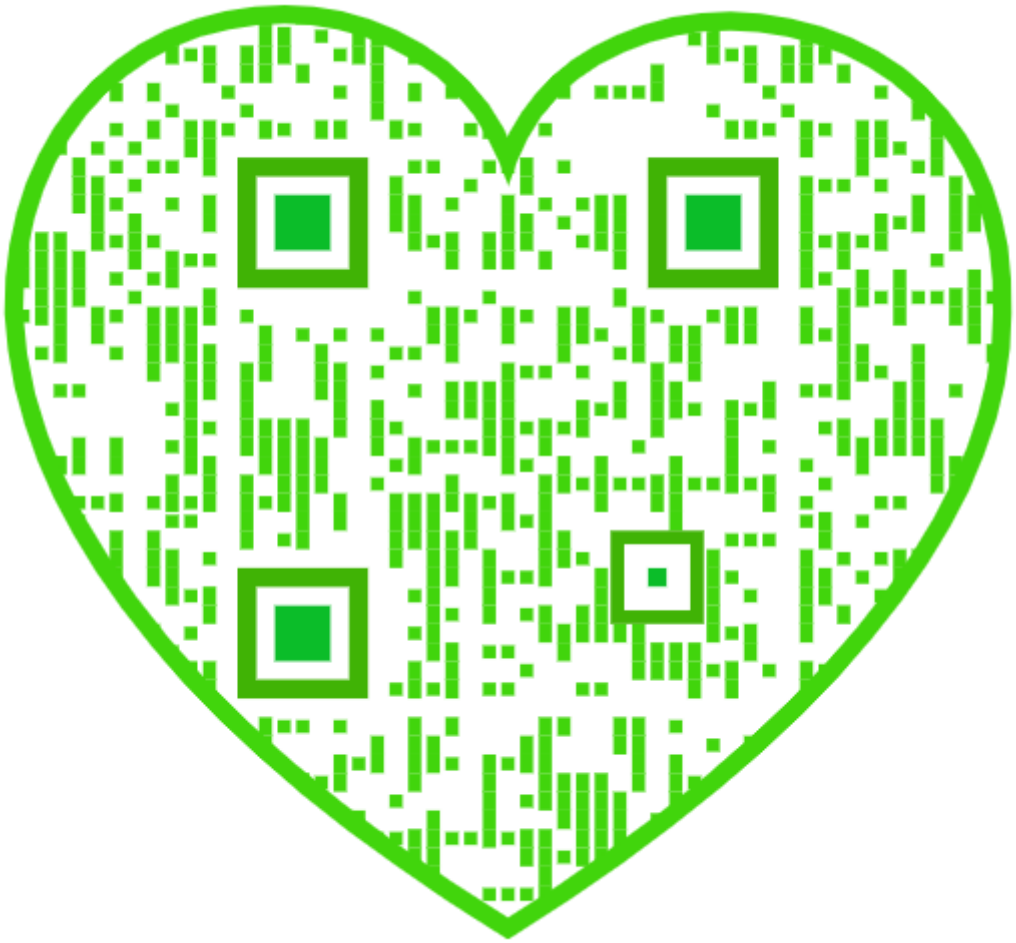

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NEW YORK, SATURDAY, AUGUST 14, 1880.

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RAILWAY PROGRESS AND REQUIREMENTS.

The enormous growth of our railway carrying business, which exacts an amount of work always in increasing proportion to the facilities for its performance, gives great prominence to all questions connected with car construction, improvements in locomotives, and economy in every detail of operating. At the late Convention of the Master Car Builders' Association at Detroit, as at the previous meeting of the Master Mechanics' Association at Cleveland, many subjects of this character were discussed at considerable length by men who not only have a practical acquaintance therewith, but whose interest leads them to make careful investigation and comparison of results obtained in the actual working of the different roads of the country. It is, perhaps, hardly the province of such associations to decide absolutely what shall be done in regard to the general adoption or discarding of certain forms of construction, or the materials to be used, nor is it likely that they could arbitrarily dictate to their employers, the railway companies, as to such points, and for this reason the results of much of their work appear on the surface to be quite inconclusive. There can be no doubt, however, that great practical benefit has resulted from their discussions and comparisons of experiments made. Of the Master Car Builders' Association, the late meeting constituted the 14th Annual Convention, while the Master Mechanics' Association this year held its 13th Annual Convention.

Mr. Leander Garey, of the New York Central and Hudson River Railroad, and President of the Car Builders' Association, places the increase in freight tonnage since 1870 at more than 100 per cent, and says that, although there are times during each year when it is difficult to find storage room for idle cars, it is impossible, in the busy seasons, to furnish the number required. During such periods the cars are loaded much beyond what they were intended to carry, and so it has frequently occurred that cars meant to carry only 10 tons have been made to take 12 to 15 tons. The increased freight offerings are expected within a few years to call for even double the present capacity, and President Garey thinks it is evident, from past experience, that in a short time the maximum load for 8-wheel freight cars will be at least 20 tons, while 4-wheel cars will be loaded with from 10 to 12 tons each, making the present ordinary freight car a thing of the past. Already the sizes of car axles have been increased by many of the builders, and this has enabled the railroads to increase the allowable tonnage on cars so built, but there are many other details in regard to which builders are invited to anticipate the future wants of the roads, rather than wait till they are forced to make necessary changes.

The general substitution of iron for wood and steel for iron in car construction, with such arrangement and proportioning of the parts as will secure the greatest strength with the least possible weight, is one of the directions in which particular improvement is looked for. In Europe it is claimed that iron has been proved to be better, cheaper, and lighter than wood for this purpose, and many patents have been issued here covering forms of car construction in iron and steel, but thus far such cars have not been largely used. The tendency is to make the iron car bed much heavier than necessary, and, with sheet iron sides, there is a great deal of trouble from rusting. The large advance in the price of iron and steel last year is said to have afforded the principal reason why no greater progress has been made lately in their substitution for wood in building cars.

The question as to what is the best style of brake for freight trains has engaged the earnest attention of the car builders for some time past. There are many patented devices in this line, but no one of them has yet received general approval as being just what is wanted in all particulars. Such a brake must, say the committee of the Car Builders' Association, be automatic and always reliable, and be applicable and operative on any car equipped with it, without regard to its location or the presence of other cars not so eqnipped in the same train. The perfecting of such special brake has only been sought within the past three or four years, but great progress has already been made toward the attainment of the objects sought.

In regard to cast iron and steel-tired wheels, wrought iron wheels with steel tires, and paper wheels, accurate results of trials on several leading railroads were given by different members at the meeting of the Car Builders' Association, but hardly enough data have yet been collected to make it apparent which kind of wheel, considering cost and amount of work done, would be best for general use. As to the size of wheels to be used, the general opinion seemed to be in favor of 42 inches, such wheels now being adopted to a considerable extent in the place of the old 33 inch wheels. On a level track and good roadbed it was said that 4 to 5 per cent of power was saved by the use of the larger wheels, though this was about all lost on up grades.

The rules under which the different companies exchange cars provide that where wheels have flat spots of 2½ inches or over the cars need not be accepted. These flat spots generally come from the wheels sliding on the rails, when they are held firmly by the brakes. It is not the intention to have the brakes hold the wheels fast, but only to check their motion, and let them slip under the hold of the brake, as this stops the motion of the train quicker, but with the varying weight resting upon different wheels this is so imperfectly attained that many flat spots are made on the wheels. When these spots exceed 2½ inches the wheels must be taken out and replaced at the expense of the company to whom the car belongs. The necessity for such and other repairs, which have constantly to be made, render it very desirable for the car builders, as far as possible, to follow a uniform plan of construction.

The fact that various lengths of gauges are employed for setting wheels for the same gauge of track presents a serious problem in the working of trunk lines, over which the cars of many different companies are run. Some of the roads have made the gauge of their tracks 4 feet 8¾ inches, instead of 4 feet 8½ inches, in order to better accommodate the different gauges at which the wheels of various companies are set, the difference in the lengths of gauges at which wheels are set varying something like one inch. On crooked roads there must, of course, be more lateral play, and this is generally found on the roads in New England. The result of a want of harmony among the companies on this question is that while, in some cases, cars will get between the tracks, in other instances the wheels fit so tightly between the rails that a good deal of power is lost in running trains. It would seem that, in a matter of such great importance, and yet involving only the most elementary principles of mechanics, it ought not to be difficult to secure substantial harmony between the railways of the country.

At the Railway Master Mechanics' Convention the questions discussed embraced the desirability of different forms of locomotive boilers; the best manner of annealing steel sheets after flanging; button boiler riveting, and the prevention of smoke in locomotives. Valuable information touching the latter point was furnished by the master mechanics of several leading railways. The first and most important element in the prevention of smoke was conceded to be in having the locomotive boilers of the largest possible capacity consistent with a proper and safe weight upon the rails; the condition coming next to this in importance was more care in firing, so that the fuel should be varied in proportion to the amount of steam required with different loads, or in going up and down grades. The committee reporting on this subject ventured the opinion that the railroad companies might better have spent money in educating men how to properly fire locomotive engines then in most of the experiments they have made with "water tables, fire-brick arches, peculiar shaped furnaces, brick walls, and mid-feathers," etc.

All of these questions, with many more of the same nature, discussed at these assemblages of men practically acquainted with the subjects, are of leading importance to inventors, engineers, and mechanics everywhere. But they have also a much broader interest, in that the general public feel directly the beneficial effects of everything done to promote the efficiency of our railway service.

Freight on our railroads is now being carried at a cost of little more than one-half of what it was in 1873—the difference between now and then on thirteen trunk lines showing a reduction of 42·31 per cent. This freight, in 1879, was carried over nearly 2,000 miles more railway, thus largely increasing the cost, had it not been for the greatly lessened expense in operating the roads. A portion of this reduction has undoubtedly been effected by improved management, but how much of it is also due to the progress made by our mechanics and inventors? And to whom else are we to look for the further improvements sought? The field is a wide one, and practical men are constantly suggesting the direction in which it is most desirable for effective work to be done, the subjects here presented constituting only a few of those which hold a leading position.

Edison's Electric Light at Sea.

In the description of the Oregon Railway and Navigation Company's new steamship Columbia, in the SCIENTIFIC AMERICAN of May 22, special mention was made of the employment of the Edison electric lamp throughout the vessel. On the arrival of the Columbia at Portland, Oregon, July 26, the chief engineer reported that the system had worked with entire satisfaction during the whole trip in all kinds of weather. The ordinary skill of the engine room was sufficient for the management of the electric generators and the lights. This is the first application of small or incandescent electric lamps to the lighting of a ship's stateroom and saloons.

Trial of the Steam Catamaran.

The trial trip of the steam catamaran, Henry W. Longfellow, built at Nyack on the Hudson, took place July 28. The vessel behaved well; but the experimental propeller proved a failure. The partially submerged screw did not take hold sufficiently, and merely churned the surface of the water into foam without giving much headway to the boat. By substituting a submerged propeller with longer and broader blades, the builder is confident of attaining a speed exceeding twenty-five miles an hour.

A Lady Patentee Pleads her own Case.

We report in another column the suit of Helen M. McDonald *vs.* Sidenberg for infringement of her patent skirt protector. The case is interesting from the fact that the lady appeared in court as her own lawyer, and came off with flying colors, although she had for her legal opponent one of the ablest limbs of the law, Mr. Counsellor Dickerson.

A LARGE CARGO.—The cable steamer Hooper sailed from Boston, July 16, with probably the largest cargo that ever left that port. The Hooper carried 160,000 bushels of grain, 525 cattle, 1,450 sheep, 12,000 bags of flour, and about 400 tons of general merchandise.

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THE EVOLUTION OF IDEAS.

Science declares that ideas are the results of the same natural forces which act in organic nature; and mental phenomena are not different from other natural phenomena in kind, but only in greater complexity. Herbert Spencer says: "All impressions from moment to moment made on our organs of sense stand in direct correlation with physical forces existing externally." "But how," he continues, in another chapter of his "Principles of Philosophy," "can we interpret by the law of correlation the genesis of those thoughts and feelings, which, instead of following external stimuli, arise spontaneously? . . . The reply is, that the immediate correlates of these and other such modes of consciousness are not to be found in the agencies acting on us externally, but in certain internal agencies. The forces called vital, which we have seen to be correlates of the forces called physical, are the immediate sources of these thoughts and feelings; and are expended in producing them. . . . That no idea or feeling arises, save as a result of some physical force expended in producing it, is fast becoming a commonplace of science; and whoever duly weighs the evidence will see that nothing but an overwhelming bias in favor of preconceived theory, can explain its non-acceptance." These words of the renowned English philosopher express the opinion of all those men of science who approve the theory of "evolution," and the object of this paper is to show how the results of the scientific investigation of ideas support this theory.

Evolution in nature is always going on from the unconscious toward self-consciousness. The highest stage it has reached on our globe is man, and with him terrestrial development has arrived at a remarkable turning point. It seems not to proceed, at least for the present, in a further organic evolution, but only in a higher development of consciousness. Intellectual evolution has become predominant, and the unfolding of ideas has become more significant than the creation of new organs.

Instead of producing higher organisms, nature has given to the human species the faculty of invention. By means of this faculty man has transferred the form of the human organs, as well as their functionary and formal relations, to the instruments he invented, and the productiveness and receptiveness of the former have thereby been remarkably increased. The evolution of ideas has thus accomplished what the further development of organisms would have done.

When we study the construction of our most important instruments we discover to our astonishment that the latter are true copies of some parts of our body, and simply a further completion of them.

In the first stone hammer man has unknowingly imitated his forearm with closed fist; in the shovel and spoon we see the forearm and hollowed hand; in the saw we find a reproduction of a row of teeth; tongs represent the closing together of thumb and fingers; in the hook is a bent finger reproduced; the pencil is simply a prolongation of the forefinger; so, we see in all instruments, from the simplest to the most complicated, only an improvement and completion of the human organs; and thus we find that all the inventional thoughts of men are directed toward the same aim as that toward which organic development tends.

But here we have first to answer an objection. Some might say, that this imitation of organs was intentional, or that man may have found instruments which resembled those organs and recognized them as most useful for the purpose. Though this explanation may not seem to us satisfactory, let us take it for granted. There could yet have been no conscious imitation of *interior* organs, of which the following furnishes some beautiful examples: From the most simple magnifying glass to the compound microscope, we find nothing else but an imitation of the lens in the animal eye; and these instruments were invented long before anything was known of the anatomy of the eye; yes, even more; the invention of these instruments has helped to solve a physiological problem hitherto unexplained, and the construction of the camera obscura and the daguerreotype has taught us the composition of our own seeing apparatus. When the telescope was invented, the discovery was made that colored margins which surrounded the objects disturbed the clearness of the view. This inconvenience was overcome by constructing object lenses composed of two different kinds of glass (crown and flint glass), which rendered these instruments perfectly achromatic. What was the astonishment of scientific men, when the fact was revealed that in the human eye there are also two refractory substances, the crystalline body and the lens, which render the sight achromatic. The construction of the human ear gives us another interesting proof, and we were only able to understand it after the invention of the piano. Corti's strings are a regular graduated series of strings which correspond to the strings of the harp or the piano, and just as each of the strings of these instruments resound only when a corresponding sound strikes it, so do Corti's strings in the ear.

In the same manner the construction of the organ has given to physiology the explanation of the organ of speech, and partially explained the mechanism of the heart. The late Prof. Dove has summed up the result of these facts in the words: "We only understood the mechanism of our own organs when we had unconsciously reproduced them by the exercise of our inventional faculties."

After a careful consideration of the facts before us few will doubt that in the invention of instruments we have reproduced the human organs, though some one might suggest that this reproduction is not the result of the action of natural laws, but only the consequence of careful contemplation, and say that in nature, as well as in technics, there are mechanical problems to be solved, and as in the former success is granted by natural selection, so in the latter by industrial progress, that a reproduction of organs can scarcely be avoided, for, if in our instruments the power and usefulness of our organs are to be extended, it is only natural that we give them a corresponding form. The weakness of this reasoning will be apparent if we show that in those products of our thought, which are not the results of a mere practical tendency, and where a further completion of the human organs was out of question, in products where our intelligence had seemingly a perfectly free field for operation, we have been directed by the same laws and led by the same tendency, which is the basis of all organic development. We are speaking of the products of art. Shakespeare, in his "Winter's Tale," says "art is but nature," and Schopenhauer calls a work of art "an anticipation of that which nature intends." One of the most interesting proofs of this fact is to be found in A. Zeising's book,* in which he speaks of the "golden cut."

The "golden cut" is the name given by German mathematicians to that division of a whole into unequal parts, whereby the smaller part is related to the larger as the larger to the whole, or *vice versa*—the whole is related to the larger part as the larger to the smaller.

Zeising endeavors to show that in this law is embodied the ground principle of all formation in nature and art, where the tendency is toward the total and the beautiful. He calls this law the ideal type and normal measure of all things, and recognizes it in the morphology of animals, of plants, of crystals, in the proportions of sculpture and painting, and even in the musical proportions. It cannot be denied that this discovery is of the highest value for the study of æsthetics. Although this principle had been long recognized in nature, Zeising was the first to demonstrate that it was represented in works of art, and illustrates in a very clear manner that it forms the basis of beauty in the "Apollo of Belvedere," in the "Antinous," the "Venus of Medici," the "Venus of Praxiteles," the "Eva of Raphael," etc.

Those who accept the dogma of free will can never find a satisfactory explanation of this remarkable fact, but it is easily understood if we admit that our ideas and thoughts are produced by natural causation, and are the result of unchangeable laws.

In works of architecture the same principle is repeated, and this is an additional proof that the activity of genius and the conception of an artistic idea are only the result of natural laws pervading the artist. The measures and proportions of different Greek buildings harmonize in a remarkable manner with the law of the "golden cut." We mention only the Parthenon in Athens, the Propylæa of the Acropolis, the Erechtheum, the Theseus Temple, the Temple of Apollo Epikurios, the Temple of the Olympic Jupiter in Agrigentum, the Propylæa of Eleusis, the Temple of the Capitolinic Jupiter in Rome, the most ancient of the temples in Selinuntum, etc. We also find the law of the golden cut in Gothic architecture—in the dome of Cologne, the Cathedral of Elizabeth in Marburg, and with more or less precision it is represented in nearly all cathedrals of the world.

That the rule of the "golden cut" was not known as an æsthetical principle, but only felt instinctively, is evident from the fact that only in a few cases it has been strictly observed; in all the others it is simply approached.

And now, after having seen the invalidity of the argument of conscious imitation, let us return to the technical sciences. It cannot be denied that in these sciences consciousness plays a more important part than in merely artistic conceptions. Very often there is a prefixed tendency to be recognized in the construction of machines and instruments, which are invented to supply a deeply felt want, and most of them are the product of careful and conscious meditation. But we have already seen that *meditation* and not *consciousness* is the productive element.

The truth of this assertion can be found by a careful study of technical development, and has been perfectly well recognized by Prof. Reuleaux,† who is perhaps the most able connoisseur of machineries. Among other things he says:

"When one observes the development of the technical sciences one is tempted to believe in a perfect *self-acting* evolution of ideas. . . . Everywhere we see how one idea unfolds from the other, as the leaf from the bud or the fruit from the blossom, just as in nature everywhere each new development is the product of some previous forms."

The development of technical sciences is based upon a continuous increasing of relations between man and the external world, and is perfectly identical with organic evolution, which takes place under a further differentiation of organs with increasing adaptation.

But this is not only true of this single phase of culture. The same organic construction is to be found in the whole world of thought.

Ideas unfold and evolve one from the other, and differentiate strictly according to the law of evolution.

In the history of the human mind there is to be found a process of adaptation of conceptions to reality. In this process there is a competition, an elimination of the "unfit," that is, of the *error*; and here likewise, as in organic nature, the greater adaptation—that is, the higher truth—leads to victory. It is the old law of the "survival of the fittest." And to make this analogy more complete, and to give it the worth of a real analogy, our thoughts are not coming to appearance in an arbitrary manner, but in a consequent order. They come forth when the foundation of their existence is laid, and not singly but in groups, which bear the same general character. "Each age," says Goethe, "hovers in an atmosphere of familiar ideas, and it is quite natural that the same discoveries are made by different persons perfectly independent, yet nearly at the same time, just as in different gardens fruits of the same species fall from the trees at the same season."

When the world is ripe for certain ideas they are produced. Before each great discovery a kind of fermentation seizes the minds of humanity, and it is the task of the genius to concentrate the thoughts of his time and bring them to a conclusion.

G. G.

*A. Zeising: "Neue Lehre von den Proportionen des Menschlichen Koerpers." Leipzig, Weigel, 1854.

†Reuleaux: "Theoretische Kinematic," Braunschweig, 1875.

THE PREVENTION OF VIRULENT DISEASES.

One of the most promising discoveries, since Jenner's day, in connection with the nature and treatment of virulent disease, has recently been made by the eminent investigator of microscopic life, M. Pasteur. A full report of the investigations leading up to the discovery will be found in the SCIENTIFIC AMERICAN SUPPLEMENT. In studying the microscopic organism which is the cause of that malignant disease of poultry known as chicken cholera, M. Pasteur finds this disease to be a connecting link between those virulent diseases of man and animals known to be caused by living virus and other diseases in the virus of which life has never been demonstrated. He finds also that under suitable treatment the nature of the virus of chicken cholera may be so modified that it will no longer produce virulent disease, but only a mild disorder, which, however, protects the animal organization against the fatal disease just as cow-pox protects humanity against small pox.

In the study of the microscopic germs of chicken cholera, M. Pasteur employs a broth made of chicken flesh neutralized with potassa and sterilized by high temperature. In this liquid the organism multiplies with astonishing rapidity just as it does in the bodies of poultry. If a few drops of a cultivation of the organism be fed to chickens the disease is quickly propagated, and the infected chickens transmit the disease to others. Repeated cultivation, by sowing in fresh broth a minute quantity of infected broth, does not weaken the virulence of the germ. But by a modified cultivation, the nature of which is not disclosed, the virulence of the germ is diminished, so that when chickens are inoculated with it they are sickened but not killed. And it is found that chickens which have had the mild disease are practically incapable of taking the malignant disease. The analogy of the behavior of the mild, artificial chicken cholera, to that of cow-pox in preventing small pox, is quite complete. M. Pasteur finds further that the attenuated virus most probably keeps its character of mildness after passing through the animal organization.

The possible outcome of this discovery covers a far wider field of sanitation than at first sight appears. It gives a clew to the nature of many of the worst scourges of humanity, and holds out the promise that when the viruses of such diseases as measles, scarlet fever, typhus, plague, yellow fever, and others, have been similarly investigated, it may be possible to develop mild disorders, by means of which the more virulent forms may be greatly mitigated in severity, if not entirely stamped out.

Earthquakes and Volcanic Eruptions.

The month of July has been characterized by seismic disturbances of more or less severity over many and widely separated regions. In the fore part of the month an earthquake at the island of St. George, one of the Azores, resulted in the formation of a new island, 600 yards distant, and about 18,000 square yards in extent.

About the same time, Sunday, July 4, an unusually severe and widespread earthquake was experienced in Switzerland. Several meters of the summit of Schnebelberg, near Quarten, fell, overwhelming a large forest. Two persons were killed by falling structures.

On the 13th seismic disturbances began in the Philippine Islands, and continued for several days. On the 21st an earthquake unequaled in severity since 1824, destroyed a large part of the city of Manila and killed many of the inhabitants. All the volcanoes of the islands were in full activity.

On the 20th New Hampshire experienced an earthquake shock of considerable severity, but noticeable chiefly as a symptom of the prevailing uneasiness of Mother Earth. The same may be said of the slight volcanic outbreak at Vesuvius.

Dispatches from Panama, July 17, speak of the exceeding activity of the long silent volcano Fuego, near the city of Antigua. The heavens for miles around were filled with smoke and dust. The first outburst occurred on the night of June 29. As seen from the deck of the Pacific mail steamer Wilmington, at a distance of nearly 50 miles, the spectacle was magnificent. From the highest peak of the Fuego great columns of flame darted up into the air to a height of from 400 to 500 feet. The surrounding country to the east and south was illuminated by the tremendous glare of the flames, while to the northward and westward the clouds of dust and smoke obscured the whole country.

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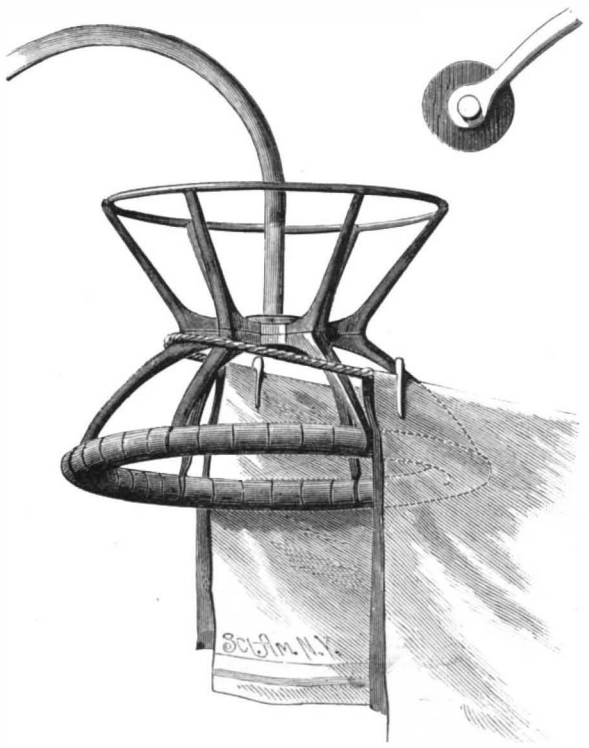
NOVEL CLOTHES LINE PULLEY.

The engraving shows a pulley for supporting a clothes line, which will admit of pulling around the line, together with the clothes supported by it, without injury to the clothes, making it convenient to place the clothes on the line or remove them from it without change of position. This is particularly advantageous when the ground is wet or snow covered, or in cold weather, as it admits of placing the clothes on the line while the person is under shelter and on dry footing. With this pulley one end of the line may be supported in a position ordinarily inaccessible, and the line may be a great distance from the ground, as it must necessarily be in some of our tall flats and tenement houses.

The invention consists of a wheel, from whose hub several curved arms project outward and downward, and several corresponding straight arms project upward, with a ring fixed over and upon the points of each set of arms, the



PAYNE'S CLOTHES LINE PULLEY.

lower ring being completely filled with small rollers, which prevent the chafing of the clothes. This pulley is supported by a curved iron rod, and the clothes line passes around the smaller portion, as shown in the engraving.

This invention was lately patented by Messrs D. H. & J. H. Payne, of Troy, N. Y., who should be addressed for further information.

NEW FOLDING BOAT.

The boat shown in the engraving may be folded into a very small space, and is well adapted to the use of hunting, fishing, and exploring parties. The frame consists of a series of bows, connected by a set of lazy tongs, which are pivoted to all of the bows except the last one at each end. The lazy tongs at the side of the boat are made of flexible material, such as thin tempered steel, but the lazy tongs forming the keelson are much more rigid. They are sufficiently stiff to keep the bow and stern braced apart when the frame is extended. The shell or covering is made of canvas, sewed into suitable shape to be stretched neatly and tightly on the frame when extended. The edges of the covering are provided with eyelets, through which a cord passes for fastening the cover to the frame, a hook being attached to each rib for that purpose.

The boat is provided with one or more seats which fold as the boat frame is folded. Fig. 1 shows the boat extended ready for use, and Fig. 2 represents the frame folded up. This invention was recently patented by Messrs. T. W. B. Murray and C. J. Baker, of Chicago, Ill.

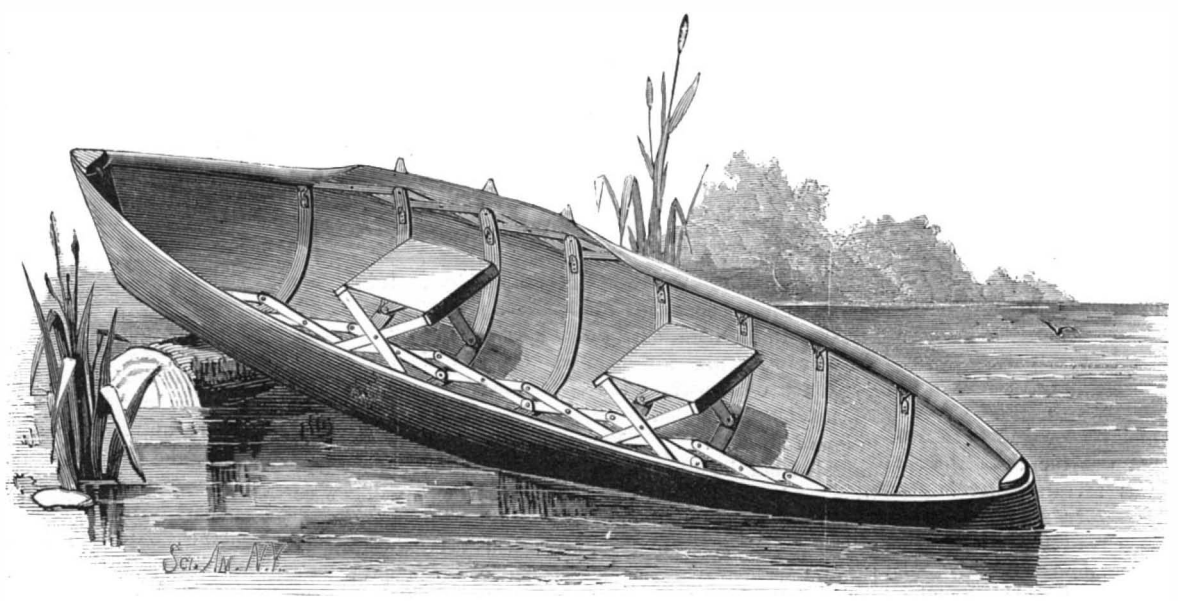


Fig. 1.—NOVEL FOLDING BOAT.

Well Marked for Identification.

The body of an unknown man, elaborately tattooed, was found floating in the Mississippi River, near New Orleans, July 8. On the back was pictured the crucifixion, with the Virgin kneeling at the foot of the cross. This extended from the nape of the neck to the middle of the back. There was a star on each shoulder, with the medallion of a lady in the center; on one shoulder a shield, with a ship in the center, and the name "Independent" on it; on the chest an American eagle, two crossed American flags, surrounded by a wreath of laurels; on the right arm two lovers in the act of kissing, and a sailor boy holding a rudder; on the left arm a tomb, with the inscription, "In memory of my mother," and a bouquet of flowers extending from the elbow to the wrist. On the back of the left hand was the letter H.

A VISIT TO THE TESTING STATION OF THE INDUSTRIAL ACADEMY, BERLIN.

This morning was occupied with another visit to the "Versuchsstation" of the Gewerbeschule, with the intention of noting the progress of certain of the "Dauerversuche." I found, unexpectedly, Prof. Spangenberg and his assistants in the midst of an exhibition of the whole apparatus and specimens of material belonging to the station to a class of twenty or more students, accompanied by the rector, Prof. Geheimrath Wiebe, and Engineer Brauer, of the Royal Polytechnic School, and Captain Nicholas Nevakhovitch, of the Russian Legation. The exhibition lasted about four hours, including the testing of a piece of Krupp's cast steel an inch in diameter.

As soon as possible, however, I got into the rooms where the "continuous experiments" are carried on. There are three rooms, of 20 to 25 feet square, occupied with machinery running during the day; one of these is devoted to the two horse power gas motor which, at an expense of 75 cents per diem, furnishes the power. Add to this the cost of such specimens as are purchased, attendance of two men, interest on machinery and room occupied, and we have the running expenses of the station. No such engine as the "Baxter" or "Diamond" is made in Germany, though gas motors are much used.

In the first room are four compound machines; they are old and dirty; some of them were made more than twenty years ago, but they do the work intended. The first machine twists a piece of iron, ⅞ inch diameter and 15 inches long, first to the right, then to the left, backward and forward, day after day, until it breaks. The amount of strain to which it is subjected is each time the same, being regulated by a heavy steel spring. In the next room are two other machines of the same sort twisting away on steel rods. They are arranged to work in any one of three ways. The rod can be twisted to the right, allowed to come part of the way back, then again twisted, and so on; or it can be allowed to come entirely back to its natural position; or, finally, the machine can be so arranged as to twist first in one direction and then in the reverse.

Next to this machine stand two for experimenting on tension. Each has four heavy compound levers; at each depression these stretch pieces of iron or steel until they finally give way. The number of pounds strain put on the pieces is, in each case, perfectly definite and constant, and is made so by springs which rise when the desired amount is reached. These rods are about ⅜ inch in diameter and 6 or 8 inches long. The pieces gradually elongate, and the springs are screwed up to follow them. At last the weakest point is found, and the elongation becomes more rapid until the breakage occurs. Next to these stands a machine where six bars, some copper, some iron, are continuously bent under the same conditions. Some are allowed to return to their natural straightness between the distortions, others come back only part way. The general size is 30 inches long by 2 wide and ¾ or ½ inch thick. Copper springs back, within certain limits, as well as iron or steel.

We now enter the second room, where two similar machines are engaged upon other bars. One machine is bending three bars 5 feet long and four bars 2½ feet long; the other works on bars of 30 inches. In this latter machine a most interesting experiment is going on. Two pieces of steel, 30 inches long and ⅝ inch diameter, were tested for their coefficients of elasticity by observations made upon the musical tone which they gave when set in longitudinal vibration. One piece was then put in the machine, and after it had been bent a certain number of times the similar piece was put by its side. When the first piece breaks it will then be known about how many bendings remain for the second piece, which, however, will not be broken. This piece will then be tested again and the new coefficient of elasticity determined. At present, while the peculiar changes of structure are going on the bars will give no pure musical tone. The one side of them is crystalline, the other homogeneous, and this latter part is gradually extending over the whole section, so that meanwhile the bar has two coefficients of elasticity, and gives a confused sound. The remaining two machines are of a different kind, and each are at work upon six bars of round iron and steel about 15 inches by 1 inch diameter. These bars are fastened in the ends of horizontal shafts, and have a bending strain applied to their ends by means of heavy steel springs which pull them downward. The shafts revolve about fifty times per minute, and it will thus be seen that at every revolution the rods are bent successively in all directions. The rods are turned cylindrical, so that in common with the prismatic bars, which are being bent, they have their weakest point in a definite place, while in the cases of tension and torsion of cylinders the whole rod is equally strong, disregarding the slight variations in the metal. To all the machines there are counters attached for registering the number of revolutions or vibrations, and on a slate some of the main figures are posted. According to this the whole

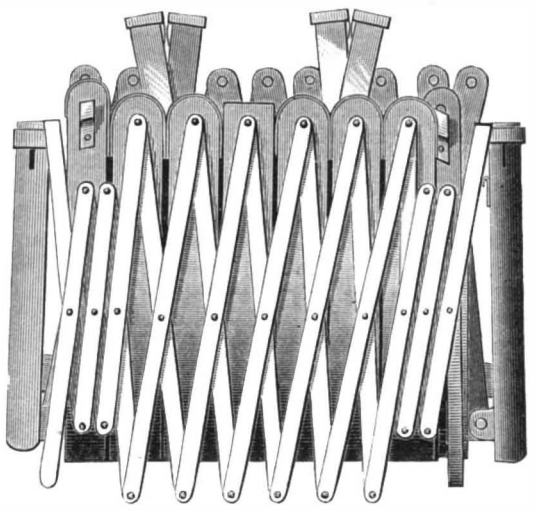


Fig. 2.—NEW FOLDING BOAT.

number of revolutions made by the machinery is over 80,000,000. All the machines run at the rate of 50 or 60 per minute, and when a piece is put in or taken out the position of the counter is simply registered in the proper book, thus giving at once the number of strains and the dates between which it was experimented upon. I understood that two rods of steel had been bent over 20,000,000 times already, and bid fair to stand some millions more. J. BURKITT WEBB.

Berlin, 1880.

ENGINEERING INVENTIONS.

Mr. James Duff, of Peoria, Ill., has patented a process of casting malleable iron and steel, which consists in simultaneously melting and deoxidizing these metals, and then, while in this same molten state, and without access of air, immediately pouring the metals in an atmosphere containing no oxygen.

An improved fire escape ladder has been patented by Mr. John F. H. King, of Port Richmond, N. Y. The invention consists in a mast mounted upon a truck, so as to be raised and supported in a vertical position for sustaining a swinging ladder when the escape is in use, and to be lowered with the ladder into a horizontal position on the truck for transportation.

Mr. Thomas Aveling, of Rochester, England, has patented an improvement in road engines, the object of which is to enable road locomotive engines of six horse power and upward to be used on railways the usual gauge of which is less than the gauge required for the road wheels of engines of such capacity. Hitherto it has been the practice to place the driving gear (or the greater portion thereof) between the boiler and the driving wheels, which necessitated a great width of gauge. To provide for a narrower gauge without altering the dimensions of the boiler, the inventor proposes to rearrange the gearing for working with two speeds, and also to place the gearing within the width of the boiler, and also to key all of the gear wheels firmly on their shafts, and thereby to avoid the inconvenience arising from the use of pinions sliding on feathers.

An improved railway switch has been patented by Mr. James M. Moore, of Canton, Conn. The object of this invention is to arrange the movable switch rails so that they can be operated by the engine as it passes along the track, and so that the moving of the rails and the locking and unlocking of the switch can be entirely under the control of the driver of the engine.

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IMPROVEMENT IN STOVES.

The cone attachment shown in the annexed engraving is designed to economize fuel, improve combustion, and to utilize to the fullest extent the heat of the fire. A hollow cylinder, A, having a conoidal top and two radial pipes, B, is supported in the center of the fire pot of a stove or furnace a short distance above the grate by lugs which rest on a spider supported by the lining or side of the stove or furnace. There is sufficient space between the cylinder and the grate to allow the grate to move freely.

The pipes, B, are connected with segmental covered hot air boxes, C, resting on the stove lining and against the inner side of the stove. The inner and outer faces of these boxes are apertured and provided with sliding registers, D, which are connected together and have their apertures arranged in relation to those of the boxes, so that when communication is established between the interior of the boxes and the external air, communication between the interior of the stove or furnace and the boxes is shut off, while a movement of the register in the reverse direction will establish communication between the boxes and interior of the stove. Air is admitted beneath the grate into the cylinder, A, and through the connecting pipes, B, into the hot air boxes, C, becoming highly heated in its passage. Then, by adjusting the registers, the heated air may be admitted into the room in which the furnace or stove is located, or by simple arrangement of pipes may be conducted to any other room in the house. A contrary movement of the register will direct the current of hot air from the boxes into the stove or furnace itself.

When raking down or replenishing the fire in the stove or furnace the inner perforations of the hot air boxes are closed by the register to prevent the entrance of dust and ashes.

In a stove or furnace the cylinder occupies the space that would otherwise be occupied with coal, so that with an equal amount of coal placed in a stove or furnace about the cylinder more extensive heat-radiating surface is secured than there would be in the absence of the cone. As the economic value of coal in a house furnace or stove is in a great measure controlled by its exposed radiating surface, this device must serve to increase the heating capacity of the coal.

This invention has been patented by Mr. J. H. Egan, of St. Johnsville, N. Y., who may be addressed for further information.

Fig. 1

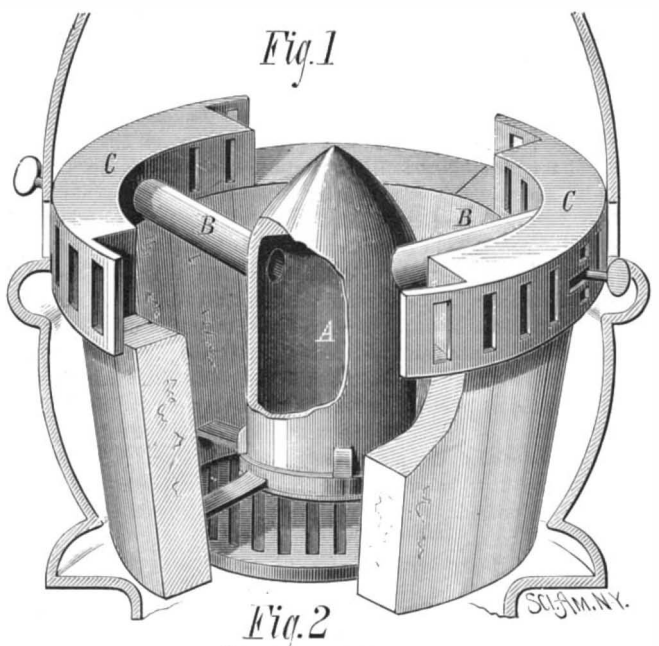
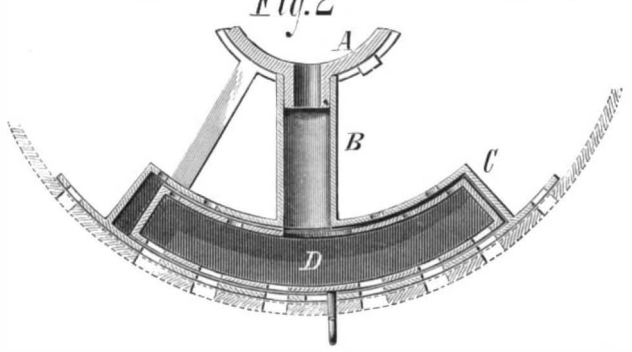


Fig. 2



EGAN'S CONE ATTACHMENT FOR STOVES.

Native Californian Tobacco.

Professor J. T. Rothrock is of the opinion that the early natives of California smoked the leaves of *Nicotiana clevelandii*—a species only quite recently described by Professor Asa Gray. It is a small plant with small flowers, and it was found by Professor Rothrock only in association with the shell heaps which occur so abundantly on the coasts of Southern and Central California. He states that perhaps of all the remains of extinct races so richly furnished by that region, none were so common as the pipes, usually made of stone resembling serpentine. The tobacco of *N. clevelandii* Professor Rothrock found by experience to be excessively strong.

IMPROVED CAR STARTER.

In the traffic of a great city like New York or Philadelphia it is no uncommon thing to see a pair of horses toiling up a grade with a car loaded to its utmost, the horses pulling almost to the limit of their strength, and when the car is stopped, as it necessarily is at very short intervals, it becomes evident that extraordinary exertions are required on the part of the horses to overcome the inertia of the heavy load and to get the car again in motion. The position of the horses, the slipping of their shoes on the pavement, and the tension of the traces all indicate that a great deal of power is required to start a car by a direct pull, and any observing person must have noticed that it requires a great deal of maneuvering on the part of the driver to release the car brake at the precise moment when the horses begin to pull. The fact is this is seldom or never accomplished, the brake being usually relieved before the horses have fairly started; the consequence is that there occurs a retrograde movement of the car, which adds to the momentum acquired by the backward movement the inertia of the load, making the matter of starting much more difficult than it would be if it were possible to start from a state of rest.

The case is the same on level roads, although not in the same degree; and, added to the effects already mentioned, there is the jerking of the passengers whenever the car is started, the racking of the cars, which results in their rapid destruction, the strain on the harness, the frequent loss of the horses' shoes, the latter being a matter of considerable importance, since the horse suffering this loss must wear a boot and go at a slow pace, often seriously delaying the entire line of cars following.

Most of what has been said in relation to street passenger cars is equally applicable to coal cars, mining cars, and railroads of every description employing horse flesh as a motive power.

It is certain that more damage is done to horses in starting the cars than in all the actual work done in drawing them along the track, and any invention calculated to avoid these evil effects is worthy of attention.

We give herewith an engraving of a nove car starter recently patented by Mr. Jacob Hansell, of Philadelphia, Pa. It has been practically tested for several months past upon some of the most trying street car lines in Philadelphia, and is found to work admirably, saving the horses from the sudden and severe strains which inevitably come upon them when starting the car in the usual way, and also effecting a great saving in the wear and tear of cars.

The invention shown in the cut is very simple, and may be readily applied to the ordinary cars. If the device is applied to a car while building, a saving of at least $5 will be effected in the construction of the car, as many of the heavier parts which are made especially for supporting the brake while under a heavy strain may be omitted.

Fig. 2 gives a general idea of the manner of applying the starter to a car, and Fig. 1 is a detail view of the starting mechanism. A ratchet wheel is secured to one of the axles of the car, and a lever, A, which embraces the axle on each side of the ratchet and carries a pawl capable of engaging the ratchet when the free end of the lever is raised. The lever, A, is connected by a short link with a bell crank lever, B, pivoted in bearings suspended from the bottom of the car. The lever, B, is connected by a rod, C, with the drawbar, D, having a spring surrounding it between the two guides, and not differing materially from the drawbars in common use.

The tongue, if one be used, is supported by a vertical rod hinged to the outer end of the draw bar and supported at its lower end by a brace, G, connected with the inner end of the draw bar and provided with adjusting nuts by which the inclination of the tongue may be changed.

The pawl on the lever, A, is connected by a small rod or chain, F, with a lever on the driver's platform, the rod or chain being connected by suitable angled levers. By this arrangement the driver may disengage the pawl from the ratchet by simply pulling on the rod or chain, F, when the motion of the car is to be reversed. When the cars always run in the same direction this pawl will never be raised. When the horses pull, the forward motion of the draw-bar moves the lever, A, upward, and as the pawl is in engagement with the ratchet, the axle is turned and the car started. The direct pull of the horses is thus applied to a car already in motion and never to the dead weight of the inert car. In fact sufficient headway is given to a car by this starter to make it impossible for a balky horse to impede the car after having given one pull. This is very important, as it insures a ready and positive start. The power is then applied directly, in the most advantageous manner, propelling the car forward for from twenty to twenty-seven inches. The drawbar being then pulled out as far as possible, the car is drawn in the usual way, until it is again stopped. In passing around curves this device is especially effective, as it transfers the pull to the middle of the car, thus diminishing the lateral or twisting strain which tends to make the car bind on the track.

The actual saving of power in starting a car with Hansell's car starter is 33 1-3 per cent. If a car is stopped on an up grade, it will be prevented from retrograde movement by the pawl and ratchet, giving the driver the use of both hands and consequently full control of the horses, the brake being entirely unnecessary, and the car will be started from a state of rest.

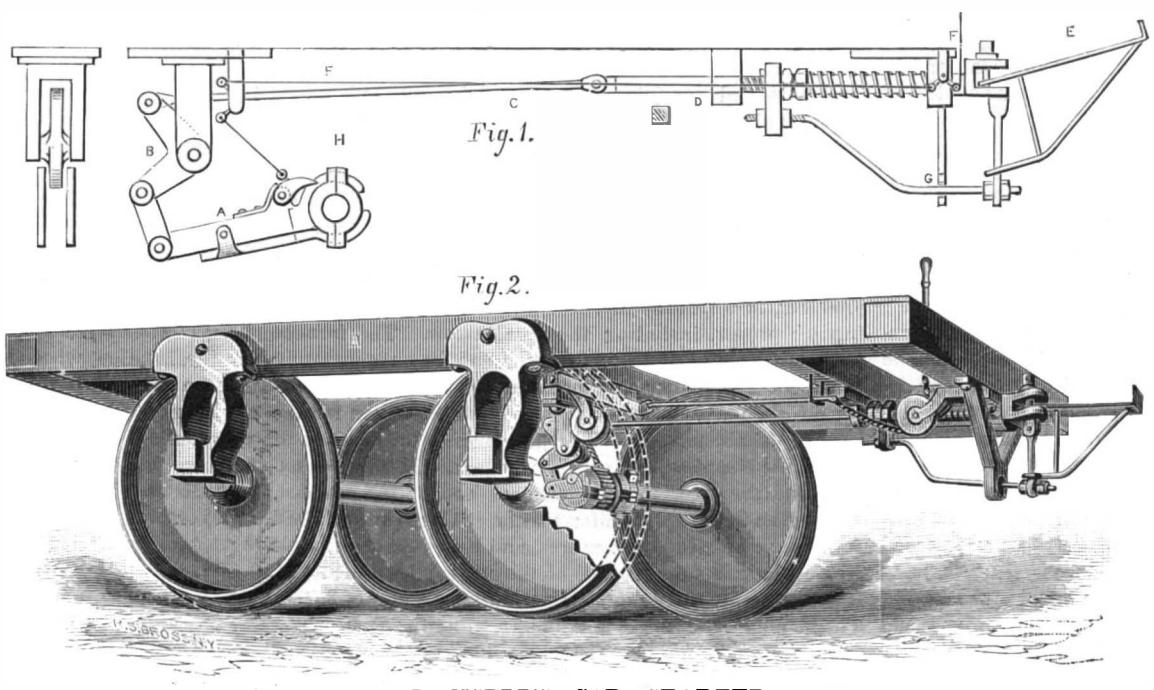
When this starter is applied to a car in the process of construction, the ratchet wheel is simply keyed to the axle; but when it is applied to cars already built, the ratchet wheel is split and is held in place by bolts.

This device relieves the horses of dead weight in starting the car, and renders the operation of car-starting as easy as car-drawing. We are informed that horses with galled shoulders have been rapidly healed while working regularly drawing cars with this improvement attached. This invention may be applied with great advantage to cars propelled by steam, the lever, A, being connected with the draw bar in substantially the same way as in the case of street cars. With steam cars as with horse cars the greatest power is exerted in starting, and the application of this device by reducing the amount of power required to start will permit of using lighter engines in propelling the trains.

This starter not only saves horses from strains which wear them out more rapidly than all the steady work they accomplish, but it saves enough every year in horseshoes alone to pay for its application to a car, and it relieves the car from the racking strains which loosen the joints of the wood work and cause every window and timber to rattle. It is stated that a car with this improvement attached will last twice as long as a car of ordinary construction which is started by a direct pull in the ordinary way. A first class car costs $1,000, and, as commonly used, becomes rickety in five years. With Hansell's car starter applied the same car will last at least ten years.

The device requires no attention whatever, needs no oil, and will outlast the car to which it is applied. It is as simple as a piece of mechanism can be to accomplish the work and is always ready for use.

Many attempts have been made to apply to a car apparatus for storing the power lost in stopping, and to expend the power thus stored in starting the car. Other devices have been tried which employ a combination of springs and



HANSELL'S CAR STARTER.

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levers to start the car, but all of these have failed either through inefficiency or from their complicated nature. It is an admitted fact that anything to be applied to a car for this or any other purpose must be perfectly simple and absolutely free from liability to get out of repair. This device has these qualities, besides being very efficient for the purpose.

There are many points in favor of improvements of this class which will suggest themselves to those practically acquainted with the management of street-car lines, and it is deserving of attention not only as a matter of money saving but from a humane point of view. Any one witnessing the efforts of horses in starting a heavily laden car can but wish that a device calculated to relieve the animals from these extraordinary strains might be put into practical use.

The inventor informs us that the car starter has been critically examined by competent engineers during its several months of trial, and they have spoken in the highest terms of its value and practicability. However, the device needs no special indorsement, as any one familiar enough with mechanics to understand its construction and operation will readily admit that it must be efficient.

For further information address Mr. Thomas H. Kemble, 617 North Sixteenth street, Philadelphia, Pa., or the Inventors' Institute, 733 Broadway, New York, where a model of the invention may be seen.

AMERICAN INDUSTRIES.—No. 54.

THE MANUFACTURE OF STEEL.

The Pittsburg Steel Works of Messrs. Anderson & Co. are among the oldest in the United States, having been established in 1845, more than a third of a century since, long before railroads became universal, and at a time when it was generally thought that fine steel must necessarily come from England. But the steel industry has outgrown almost every other manufacture, and the quality of the various products is fully equal, if not superior, to anything imported.

The Pittsburg Steel Works had a small beginning, but as time passed they gradually developed, adapting themselves to the numerous and constantly increasing wants of the country, until they now cover a larger area and produce steel for a greater variety of purposes than any other mill in Pittsburg. Its managers are men of energy, perseverance, courage, and practical ability, who have fostered the growth of inventions in the manufacture and application of steel, and whose efforts have been very fruitful in the development of industrial resources.

Wherever a particular kind of steel has been required for a particular purpose it has been characteristic of this firm to embody the new form of steel in their manufactures. As a consequence of this they have many specialties in their business, among which may be mentioned the five-plate safe cast steel, which is used exclusively by Hall's Safe and Lock Company, of Cincinnati, whose safes are largely used throughout the United States; agricultural steel, which is used in the large plow factories of the West; steel for hoes, for shovels, also for forks, harrow teeth and rake teeth; grain drill, reaper, and machinery steel, and, in fact, steel for every variety of agricultural implement. They have acquired a reputation in the Eastern States for a fine quality of steel used in the manufacture of table cutlery, which is equal to any of the Sheffield productions. They have also a large railroad trade in frog points, side bars, and heel plates for switches, and they manufacture steel for hammers, chisels, and drills, which is generally used in the quarries of New England. Most of the steel rods from which the wire was drawn for the Brooklyn Bridge was furnished by this firm.

To turn out all these products, Messrs. Anderson & Co. employ 575 men, whose wages amount to $400,000 yearly.

The general appearance of these extensive works is shown in the small perspective forming one of the views in our title page engraving, and the interior views convey an idea of some of the operations conducted here.

The plant consists, briefly stated, of five 24 pot Siemens furnaces, 3 sets of coke hole furnaces, 6 converting furnaces having a weekly capacity of 90 net tons, 3 single puddling furnaces, 16 hammers, a rake tooth shop, 10 trains of rolls, two of them being 20 inch plate rolls, one 16 inch bar, one universal train, one 16 inch spring, two 16 inch sheet, and one 8, one 9, and one 10 inch guide.

The wire rod mill was erected in 1877 on the Belgian system, with a capacity to turn out 20 tons of No. 5 crucible steel every ten hours. One hundred and fifty pots can be used at each heat in the steel works. These are run double turn, making three heats each turn, making them equal to 900 single pots daily. The annual output is 15,000 net tons, the product is cast and German plow steel, plate steel, and the best edge-tool steel. The cast steel consists of selected pieces broken and melted in the crucibles and poured into ingot moulds. It is afterward reduced to bars or sheets by hammering and rolling. One of the upper views in our engraving shows the crucible furnaces in the foreground, and the iron ingot moulds being filled with melted steel in the middle ground.

The open hearth steel works, added in 1879, contain one 15 gross ton and one 7 gross ton Siemens open hearth furnace, one blooming mill, and one plate mill. The 15 ton furnace, which is shown in our engraving, is the largest in this country.

The rod rolling mill, shown at the top of the engraving, turns out rods for wire manufacturing, and one of the smaller views shows one of the trains for rolling sheets of steel. Under the huge steam hammer shown immediately below an ingot of heated steel seems as plastic as clay.

The lower right hand view shows several of the immense shears employed in cutting agricultural steel into the hundreds of shapes in which it is required.

THE MILL IN OPERATION.

To a person unaccustomed to the scene, a sudden introduction to the whirr, clatter, and roar of a vast establishment like that under notice is confusing. Trip hammers pound, trains of rolls whirl out the flaming iron or steel, engines puff and rattle, furnaces glow with white heat, and the heated iron or steel flashes as it is drawn out. Immense shears clip great sheets of iron as easily as ordinary shears would paper. Vast grindstones smooth and polish the plow colters, and up and down, intense activity, wondrous power, and seeming confusion are apparent amid the most deafening noise. But there is no confusion. The mill is departmentized. Each set of hammers, or train of rolls, or set of shears, or engines, is under a superintendent or manager, who is responsible for the quality of the work. Rigid accountability follows every department of the work—the standard in this mill being as near absolute perfection as it is possible to reach. It seems amazing that administrative capacity should be so developed as to follow the broken scraps of steel or pigs of iron, from the weighing room, through all the stages of manipulation, till they come out in the form of the most perfect steel now manufactured in any part of the globe, and yet avoid confusion, loss of time, waste of material, or loss in any form. Yet it is done here in the quietest manner and without display of any kind. It is confusing to think of the accuracy in technical knowledge essential to the management of such works. The tensile strength, resistive force, enduring power of the product is to be considered; the combination of material, the chemical properties involved and to be produced. The changes of the rude lumps of pig iron from one quality to another, till it is beautiful finished steel, are perplexing to the uninstructed mind. And then the business aspects of the affair! They involve the closest study of economy, the successful dealing with many men, the survey of the world, its wants, demands, present and prospective, in the line of steel. The proprietor of the works under mention looks upon the broad world as a market. Every section of this country, South America, and Europe, afford the market. It broadens one's conception of the importance of our great manufacturing establishments when we realize how vast is the scope of their trade, and how closely they must study the competitive forces arrayed against them.

THE SIEMENS FURNACES.

In appearance, these furnaces resemble coke ovens, flattened at the top. The pots, containing the metal to be melted and manipulated, are let down through long, narrow slits, at the top, and are thence taken out when ready. The fuel used is gas, manufactured for the purpose, and mixed with air, and introduced under the furnaces by means of huge pipes. The heat generated rises to 3,000° Fahrenheit—the most terrible intensity of heat known to be artificially produced. The men who take out the pots of melted metal stand over these slits, at the top of the furnace, exposed for the moment to the intense heat, and with long iron pincers grasp the pots of melted metal, lift them out and pour the metal into receptacles to cool. These men have cloths wrapped around their limbs, and thoroughly saturate them with water before going to the furnaces, thus preventing the burning of clothes or body. In a moment they turn away, smoking from the intense heat.

THE SIEMENS PROCESS.

It may be of interest to our readers to know of the process by which steel is manufactured under this patent. This process was introduced in this country by Mr. Anderson. Cast steel is made from blister steel, broken into fragments, and carefully selected as to temper, placed in crucibles of plumbago, lowered into the smelting furnaces, and exposed to the heat of 3,000°. The most exact skill is required in this part of the process. When the contents of the crucible are ready for pouring they are poured into an iron flask, or mould, forming ingots of various sizes. Four hours are required to transform blister steel into cast steel. The Siemens furnace consists of two distinct parts, the producer, in which the fuel is converted into gas, and the furnace proper, including the regenerators. The furnace proper is composed of one heating and four regenerating chambers. The latter are placed beneath the heating chamber in such a manner as to leave space between for the passage of air and gas. The gas enters at the bottom of one of the chambers, the air enters the neighboring chamber, and the two, mingling at one end of the furnace, produce an intense and uniform flame. This heat is utilized entirely, passing the regenerators, and being used in various ways. Thus, by the reversal of the current of heated gas, it is thoroughly used, producing a continuous heat of 3,000°. The action of the furnace is so perfect that the gases which enter the stack through the waste flue to be cast into the air do not exceed 300° Fahrenheit. This is the process which has been in use here since 1868, when this firm first introduced it into this country.

This vast business in all its extensive ramifications requires executive ability of a high order. The established success which the works have achieved is largely owing to the untiring industry, indomitable perseverance, and persistent energy of Robert J. Anderson, who twelve years ago, in connection with other partners, purchased the business from Jones, Boyd & Co., the senior member of which firm opened the business in 1845. The business has thus changed hands only once in thirty years. The best evidence of successful management is found in the fact that all through the last several years of financial depression these works have never stopped except for repairs, having run double turn, and sometimes the whole twenty-four hours of the day. They are now turning out agricultural steels, and bid fair to have a future as successful as the past. Progressive in their ideas, fully up to the wants of the age, having all the elements of success, they cannot fail to obtain it.

Representatives of this firm are located as follows: A. B. Parker, No. 21 Astor House, New York; Wm. F. Potts, Son & Co., Philadelphia, Pa.; Carolan, Cory & Co., San Francisco, Cal.; Augustus Wessel, Cincinnati, Ohio; Tronell, Handy & Greer, Baltimore, Md., and Miles & Cotton, 170 Lake St., Chicago, Ill.

ASTRONOMICAL OBSERVATIONS AT HIGH ELEVATIONS.

The progress of modern optics is now furnishing observers with telescopes of a power which exceeds the capacities of our lower atmospheres for their constant employment. The obstacles to definition due to this atmosphere have grown to be so nearly a barrier to any rapid progress that attention has lately been given to the conditions of vision which it is very commonly supposed will be found to be best on mountain summits. There is no exact information on this subject, however, and Prof. S. P. Langley was therefore led to make some observations on Mount Etna during a visit there in 1878, and the result of which he records in the July number of the *American Journal of Science and Arts*. His object was to gather some sort of quantitative estimate of the degree of transparency and definition, to take the place of vague statement, and to give a kind of standard for comparison with sites in our own territory. The station chosen was "Casa del Bosco," at an elevation of about 4,200 feet. The observations were directed to the sole end of determining the character of vision, as tested at night on stars and nebulæ, and by day upon the sun. After a limited number of comparisons, he infers that at this station about nine-tenths of the light of a zenith star reaches us, and that only one-tenth is absorbed by our atmosphere. The gain on Etna over a lower station, as tried by the tests of a double star observer, was more in clearness of the atmosphere than in that freedom from tremor which accompanies good definition. The latter was indeed upon the whole better than below, but not conspicuously so.

Prof. Langley concludes, as the result of his researches, that the balance of advantages for astronomical observations is most likely to be found in a dry atmosphere, and certainly at a great elevation. Such elevations have undoubtedly the advantage of diminishing the atmospheric absorption of the more refrangible rays, an absorption so important that it probably cuts off from us the larger portion of the ultra violet spectrum. The gain for observations of precision will be, though positive, not in itself probably such as to justify the difficulty and expense of such a site; but for the study of the nebulæ and stellar photometry the gain is very essential indeed, while for almost every problem in solar physics it may be said without reserve that, for rapid progress, such observations have now become not merely desirable, but indispensable. The summit of a lofty mountain, however, is not a desirable station. At an altitude of 10,000 or 11,000 feet the observer may still enjoy all the conditions of health that fit him for labor, but beyond this unfavorable conditions increase very fast.

Quoting from his own experience of a stay of ten days upon Pike's Peak, at an altitude of between 14,000 and 15,000 feet, Prof. Langley says that at this height the attenuated atmosphere makes a long stay impossible for some, while even for the healthiest the conditions of life begin to be such as to render continuous hard work scarcely possible. At the same time the mountain condenses about itself continuous clouds, so that, except during a brief period in the autumn, the opportunities for observation are far rarer than on the plains. A dry climate and a table land at an elevation of something like 10,000 feet, sheltered on the side of the prevalent winds by a mountain range, which precipitates their moisture in clouds that rarely advance beyond the observer's horizon, appear to be the most promising conditions in our present knowledge. Upon the whole, though the ideal station, where atmospheric tremor does not exist, and the observer pursues his studies in an ever-transparent sky, is not to be found on any part of the earth's surface yet examined, we find, says Prof. Langley, within our own territory, in the dry and elevated table-lands of Colorado or New Mexico, every condition which experience points out as favorable.

Our Leading Cities.

Cities.	1880.	1870.	1860.
New York	1,208,471	942,252	813,669
Philadelphia	843,000	674,022	565,529
Brooklyn	554,693	395,099	266,661
Chicago	502,940	298,977	109,260
St. Louis	395,000	310,864	212,418
Boston	352,345	250,526	177,841
Baltimore	350,000	267,354	212,418
San Francisco	280,000	1 9,473	56,802
Cincinnati	246,153	216,239	161,044
New Orleans	215,239	191,418	168,675
Washington	160,000	109,204	61,112
Cleveland	156,946	92,829	43,417
Newark	136,983	105,059	71,941
Milwaukee	130,000	71,440	45,246
Detroit	119,000	79,577	45,619
Louisville	112,000	100,753	68,033
Jersey City	105,000	81,744	29,226
Providence	104,500	68,904	50,666

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Glycerine in Gastric Troubles.

Dr. Sydney Ringer calls the attention of the profession, in the *Lancet*, to the value of glycerine as a remedy in flatulence, acidity of the stomach, and pyrosis. He states that sometimes he finds all of these gastric troubles combined, but glycerine in nearly all cases relieves them. In some cases, too, it removes pain and vomiting, probably like charcoal, by preventing the formation of acrid acids, which irritate delicate and irritable stomachs. Glycerine does not prevent the digestive action of pepsin and hydrochloric acid; and hence, while it prevents the formation of wind and acidity, probably by checking fermentation, it in no way hinders digestion. He administers a drachm to two drachms either before, with, or immediately after food. It may be given in water, coffee, tea, or lemon and soda water. In tea and coffee it may replace sugar, a substance which greatly favors flatulence, as, indeed, does tea in many cases. In some cases a cure does not occur till the lapse of ten days or a fortnight.

IMPROVED CROSS TIE.

The engraving represents a light and durable cross tie made wholly of rolled iron or steel, and adapted to receive ordinary railroad rails, which are secured by a fixed and a movable clamp at each end. The body is made of steel or iron rolled in U shaped cross section, and having flaring sides of suitable depth to give it the required strength and rigidity. This form gives a broad top which affords a firm bearing for the rails. The body is attached to a base plate, B, by means of angled plates which are bolted or riveted. Angle plates are attached to the ends of the tie, forming a flange which extends downward and forms an additional safeguard against the end motion of the tie. This flange is usually applied only to ties used on curves to keep them from shifting or turning.

The rails are held in place by two clamps at each end of the tie. The inner clamps are formed with raised ends for receiving the flange of the rail, and are permanently attached to the tie by rivets. The outer clamps are similar to the inner ones, but they are attached to the tie by bolts and nuts, so that they may be removed to permit of changing the rails. The bolts may be readily inserted or removed, as they are accessible through the open end of the tie.

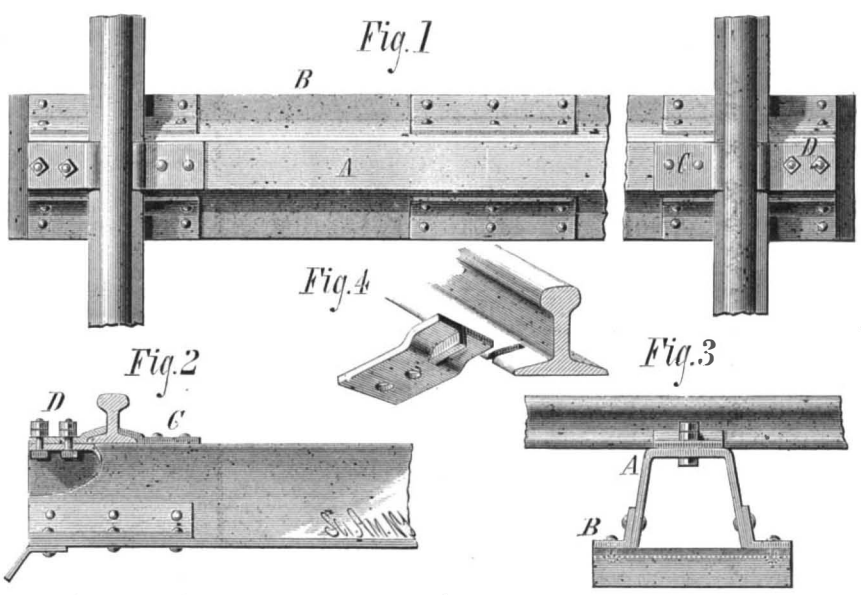
The ties will rest on the road bed, and the ballast can be tamped under it in the usual way.

To prevent the rails from creeping, the movable clamps may have lugs formed on them which may enter slots made in the rails as shown in Fig. 4. Only one tie in ten need be provided with this device.

Fig. 1 in the engraving is a plan view of the tie, Fig. 2 a partial side elevation, and Fig. 3 an end view.

The advantages of this tie over the wooden one and over other forms of iron ties will be readily seen by engineers and others familiar with the requirements. This construction secures strength, durability, cheapness, and facility of handling and application.

Further information may be obtained by addressing Mr. Louis Scofield, Chattanooga, Tenn.



SCOFIELD'S CROSS TIE.

AMERICAN MILLING AS SEEN BY AN ENGLISHMAN.

Mr. Samuel Smith, of Sheffield, President of the British and Irish deputation of millers to the late Cincinnati Exhibition, was called upon, at a reception given by the Utopian Club, to give some account of what he had seen in this country, and how the American milling industry stood as compared with the English. He expressed himself as follows:

"Among our competitors in the United States at Minneapolis, St. Louis, Milwaukee, Red Wing, and other places where the new process, or some modification of it, has been adopted, his voice would be like that of 'one crying in the wilderness.' (Laughter.) The millers in these places have thrown all that pertains to the old school to the 'moles and to the bats;' and although Mr. Z. might find some of them here and there using stiff irons, he would find few to adopt any other parts of the doctrine he expounded with so much ability at last meeting. As a rule, the organization of the American mills of the best class is perfect, and thoroughly automatic from top to bottom, every machine used in the process of flour-making being located in the right position relative to the work it has to perform. The bolting capacity of the dressing machines is much greater than that of ours, and where we use one middlings purifier, they use three at the very least. In new process milling they make all the middlings they can, which not only necessitates the employment of a larger number of purifiers, but a greater number of rollers, for softening middlings after purification, and while the entire system of machinery is worked at its highest capacity, no part of it is subjected to such a strain as to incur the risk of its doing the work badly.

"The conclusion I have come to, from all I saw in the best mills I had an opportunity of seeing, is that in order to compete with the American millers successfully there is no necessity for copying their system in anything like a slavish manner, but it is absolutely indispensable that we should adopt the thoroughness with which they do their work. They use at least four times as much silk as we are in the habit of doing in the dressing of their flour. They make more middlings than we do, and consequently use more purifiers and rollers, although in some cases stones are used for the treatment of middlings with highly satisfactory results, and if we are to hold our own we must reorganize our mills, increase our silk-dressing power, pay greatly more attention to our stones, than we have been in the habit of doing, both as regards dressing and balancing, the necessity of the latter being more than ever indispensable if the highest quality of work is required, and that, I need not say, under the conditions we are now placed, is a *sine qua non*. I certainly should not take the responsibility of recommending the adoption pure and simple of any of the specific systems which are in use in the United States in this country, partly because we cannot command to the same extent as is done in America a constant supply of the wheats that are used there. So far as our foreign supply is concerned, we must take what we can get. I noticed in an American milling paper that there was a chance of the millers of this country being able to make Minneapolis flour in consequence of the missionary efforts among us of milling experts from the other side of the Atlantic. I don't think it likely that we shall be able to accomplish that feat until we have the full supply of Minnesota spring wheat of the same quality as the Minneapolis millers have at their command. I am quite convinced, however, that by throwing our entire energies into the work, rearranging our mills upon principles which will secure for the different processes in the manufacture of flour the fullest manipulative efficiency, and adopting to the fullest extent the labor-saving contrivances which I saw everywhere in the States, and which so greatly reduces the cost of production, we could raise the quality of our own grades of flour to such a standard as would enable us to regard the competitive efforts of our American friends without any of that alarm which has been recently manifest in some parts of the country. I don't think I have anything more to say at present, but I may remark, in conclusion, that I will not readily forget the warmth of our reception in America, nor the hospitality that was so heartily extended to us."

A conversation here ensued on the remarks that had been made by the president, and the general impression seemed to be, that while there was no doubt that the reorganization of English mills to a greater or lesser extent upon principles approaching in some degree to those that had been adopted in the best mills in the United States—keeping in mind the special circumstances that controlled the action of the millers of this country, in order to deal effectively with American competition was indispensable—means must also be adopted to secure by means of special agencies under the complete control of the home trade of a fair proportion of the highest class of the wheats used with such beneficial results to their own interests by our American competitors.

Protection of Oil Tanks from Lightning.

To the Editor of the Scientific American:

Having never seen an oil tank, I can only gather by inference its mode of construction and surroundings. From the word supply, and from your statement that it is above the oil, I conclude that the pipe comes from a well at some distance, but I cannot learn that it is above ground or under it. If the pipe is underground and comes out of it a short distance from the tank, then, of course, the difference of potention between the pipe and the body of the tank will be nil, and consequently no current or spark will pass. The electro-motive force necessary to produce a spark in air, as you know, is enormous. From these considerations I think your remedy inapplicable. I should rather run a rod from the pipe up into the air, connecting it at the same time with both the top or cover and the body of the tank. This, I believe, would be more in accord with established electrical laws.

Of course, if the pipe is above ground for any distance from the tank in the direction of the well, your remedy will apply.

But another cause of the spark different from either of yours may be suggested. Oil is a well known non-conductor or dielectric, and may have a high specific inductive capacity and absorb a large quantity of electricity gradually from the earth. Being a dielectric, then, and allowing that the top or cover of the tank is insulated from the body by its style of construction, by a layer or coat of paint, thick oil, or any other way, we will have the body and the top or cover of the tank forming the plates of a condenser, with the oil or in the air or both acting as a dielectric. Under these conditions everything is very favorable for the passage of a spark between the top and body of the tank, or between either of them and the pipe, or in the reverse direction in a thunderstorm prevailing over the tank or at the distant well.

This may not be the cause, but examination in this direction should not, I think, be overlooked.

DAVID FLANERY.

Richmond, Va., July 26, 1880.

A Fast Locomotive for England.

The fast passenger locomotive lately built by the Baldwin Locomotive Works, and tested on the Bound Brook line between Philadelphia and New York, has been bought by Mr. F. W. Eames for brake trials and tests in England. It will be immediately fitted up with the Eames Duplex Automatic Vacuum Brake and shipped to London. Mr. Eames proposes, while showing the action of the Eames brake on railway trains at the highest speed possible to attain, at the same time to settle the vexed question of the relative superiority of American and English locomotives.

MECHANICAL INVENTIONS.

A device to be attached to lawn mowers for catching and holding the grass as it is cut by the mower, has been patented by Mr. Cyrus G. Baldwin, of Ripon, Wis.

Mr. Chester F. Allen, of Paw Paw, Mich., has patented an improved transfer truck for cars for transferring broad gauge cars over narrow gauge tracks without changing the truck of the broad gauge car. The invention consists in a narrow gauge truck constructed to carry a broad gauge truck, and provided with hooks for retaining the two trucks in position.

Mr. Charles F. Powers, of Sutherland Falls, Vt., has patented an improved tile facing and squaring machine, which will level and smooth by rubbing the faces and edges of several tiles at a time. It consists of revolving frames for holding and adjusting the tiles upon a rubbing bed or grinding plate or disk, and of novel devices for removing and replacing a tile without interfering with the work on the others.

Mr. Orville A. Wilson, of Bennington, N. H., has patented a cheap, strong, and durable fastening for uniting the handles and blades of knives and handles and tines of forks. The invention consists in combining a slotted handle having beveled annular shoulder, a bolster, a blade with slotted tank, and a screw bolt.

An improvement in calipers and dividers has been patented by Mr. William H. Warren, of New York city. This invention relates to measuring instruments, such as calipers, compasses, dividers; and it consists of revolving studs or pivots fixed at any convenient points on the instrument, and in combination with a slotted bar, whereby the legs of the instrument may be adjusted by means of screw and spring without loosening the clamping screws and nuts.

An improved baling press has been patented by Mr. Rufus P. Davis, of Monroe, N. C. The baling press is so constructed that the followers may be run down quickly while meeting little resistance, but slower and with great power as the bales become more compact, without forcing the bales out of shape.

Enlargement of New York Water Supply.

The works soon to be undertaken for the enlargement of the system of water supply for New York city includes the construction of a 15 foot dam at the outlet of Little Rye Pond, connecting both Big and Little Rye ponds, and forming a lake of 280 acres in extent, capable of storing 1,050,000,000 gallons. It is also proposed to build a dam on the Bronx, near Kensico, 45 feet high, making a reservoir of 250 acres, having a capacity of 1,620,000,000 gallons. A dam will be built across the Byram River 15 feet high, creating a lake with a capacity of 180,000,000 gallons. The Byram and Bronx rivers it is proposed to unite at this point.

From the Kensico dam the water will be conducted through a 4 foot iron pipe along the valley of the Bronx to a reservoir near William's Bridge in the upper part of the Twenty-fourth Ward, the elevation of which is 180 feet above tide-water and 65 feet above the Croton Aqueduct, and the capacity 100,000,000 gallons. The length of this conduit is 15 miles.

The Kensico reservoir will give the city of New York from 18,000,000 to 20,000,000 gallons more water daily. The contracts will be let August 4. It is estimated that the work will be finished in about two years, and cost about $2,700,000. By tapping the Bronx at Kensico there will be obtained not only pure water, but a remarkably good head. The country drained—over 13 square miles—is similar in geological character to the Croton Valley.

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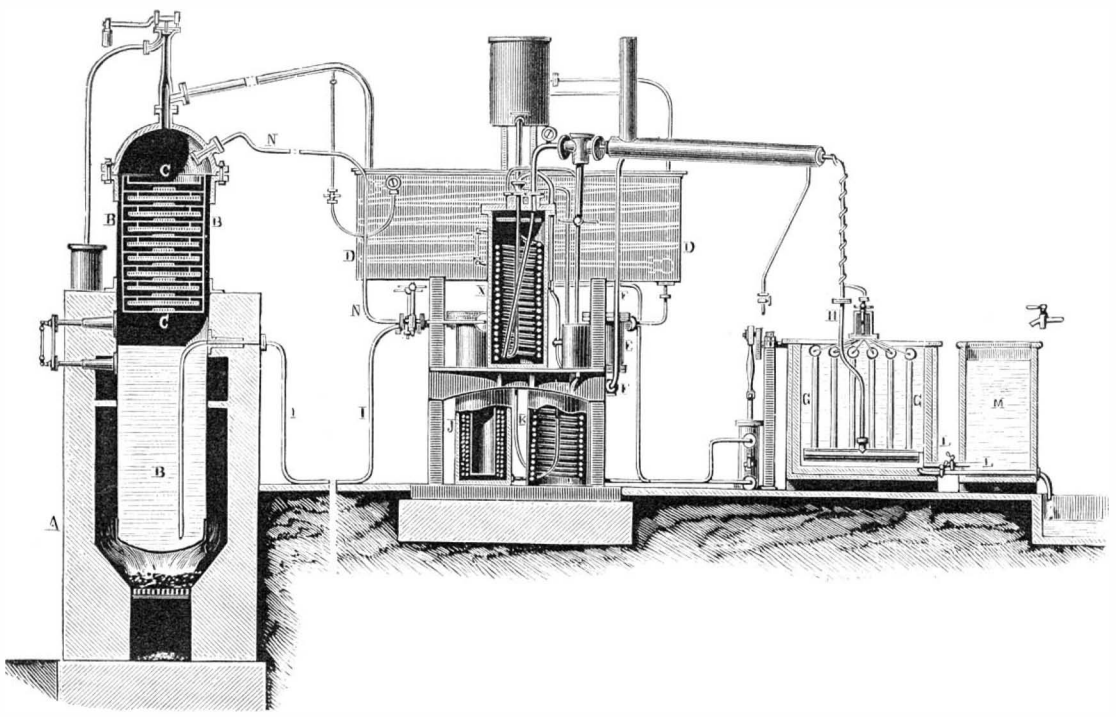
THE EXTRACTION OF THE SALTS OF SODIUM AND POTASSIUM FROM THE MOTHER LYE OF THE MEDITERRANEAN SALT PITS.

As is well known large quantities of salt are obtained in the southern part of France on the coast of the Mediterranean by conducting sea water into large basins and permitting the water to be evaporated by the heat of the sun; and it would seem as though salt could be obtained for such a low price by this method that it would not pay to utilize the residuum, but our modern economists do not believe in waste, and therefore extract as nearly as possible every particle. After the crystallization of all the chloride of sodium (common salt), the mother lye is evaporated in the open air until its density is about 32° Baumé, and is then conducted into other evaporating basins, where it abandons its mixed salts, consisting of sulphate of magnesium and chloride of sodium. After this crystallization the density of the mother lye is 35°B., and it is then conducted into large basins or reservoirs, where it remains through the winter, during which time the greater part of the sulphate of magnesium crystallizes.

The aqueous solutions, after these several crystallizations, contain almost exclusively potassic salts. To obtain the latter the solution is boiled, then mixed with a concentrated solution of chloride of magnesium, whereby a fresh quantity of mixed salts containing all the sulphate of magnesium is precipitated. The liquid is then poured off, and by cooling abandons the chloride of potassium and chloride of magnesium. To isolate the chloride of potassium it is sufficient to leave the salt in moist air and then wash it in cold water, which draws out all the chloride of magnesium. The chloride of potassium is clarified and dried, and is now ready for the industries.

In order to obtain the sulphate of soda the mixed salts, consisting of a mixture of chloride of sodium and sulphate of magnesium, are dissolved in water, and this solution is cooled by means of a powerful Carré refrigerating machine, represented in the engraving, which we take from *La Nature*. By this process chloride of magnesium and hydrated sulphate of soda of 50 per cent are obtained. But as yet this salt is not a merchantable product, and is therefore heated to about 50°–60° C., and then mixed with 20–30 per cent of mixed salts, containing from 8 to 10 parts of chloride of sodium. At about 33° C. it forms a precipitate containing anhydrous sulphate of soda. In the Carré apparatus, A is the furnace, B the receptacle for the ammonia solution, C C a rectifying device for retaining the vapor of the water, D D a worm for condensing the ammonia gases, E E a regulator for receiving the liquid ammonia and admitting it into the refrigerator, G, in which the temperature is decreased considerably by the change of the liquid ammonia to a gas. The solution of mixed salts enters in the refrigerator, G, circulates around the tubes of the same, and deposits the sulphate of soda, and in flowing through the tank, M, reduces the temperature of the liquid in the same. H H are tubes for conveying the ammonia gas to the absorption cylinder, X, where it is mixed with the exhausted solution of the receptacle, B. I I are tubes for conducting the exhausted liquid from the bottom of the receptacle, B, to the worms, J, K, in which the liquid is saturated with ammonia and cooled, and is then conveyed to the rectifier, C, by the tubes, N N.



EXTRACTION OF THE SALTS OF SODIUM AND POTASSIUM.

Surface Tension of Mercury.

The following pretty experiment, devised by Mr. R. H. Ridout, illustrates the surface tension of mercury. A shallow tray, six inches by three, is supported on three leveling screws, and inclined just so that the mercury does not flow over the lipped edge. If now a small quantity of the liquid be set flowing over the edge it will draw the rest of the liquid over with a siphon-like action. It is difficult, however, to get the surface so clean that no adherent trail should be left, marring the completion of the experiment.

THE LIVADIA.

The Livadia, the new Russian imperial yacht, was launched from the building yard of Messrs. John Elder & Co., Govan, near Glasgow, on July 7.

She is the latest development of ideas that may fairly be said to be revolutionary and subversive of all established principles of shipbuilding, and of which the earlier specimens are found only in the circular ironclads of Admiral Popoff. Speaking roughly, the Livadia must be imagined as a broad and shallow oval, half submerged, and carrying on its surface extensive lofty and sumptuous saloons and other apartments. It resembles a vessel of the ordinary kind, reposing upon a white air cushion. Its principal dimensions are: Length, 260 feet; breadth, 150 feet; depth, 50 feet; tonnage, 11,609; and displacement, 4,000.

The propelling power consists of three sets of engines, each having three cylinders, the diameters of which are: for the high pressure, 60 inches, and for the low pressure, 78 inches, with a stroke of 3 feet 3 inches. The propellers themselves are of manganese bronze, thus securing strength and lightness; and, with the view of obtaining the greatest possible power, steel has been largely used in the construction of the engines and boilers, which will be the most powerful in the world for their weight. The indicated horse power is 10,500, and the vessel is expected to make 14 knots an hour. The launch of the Livadia was the one great event at Glasgow.

NEW INVENTIONS.

An improved carriage pole foot, which is so arranged that it can be adjusted to different widths, has been patented by Mr. Henry Tine, of Danbury, Conn. The invention consists in combining a slotted pole foot and lugged guide plate with a screw bolt having a long head.

An improvement in distributing the wires of underground telegraphs has been patented by Mr. Mackintosh, of New York city. This invention relates to the leading of telegraph wires into buildings in such a manner that the wires cannot be seen from the street. The invention is an improvement upon patents for underground telegraph lines that were granted to the same inventor January 20, 1874, and January 16, 1877, and numbered 146,695 and 186,355, respectively; and it consists in leading telegraph wires or cable through suitable underground tubes or conduits to a pole or other device erected within the square inclosed by blocks of houses, and in leading the wires from the pole into the rears of the houses.

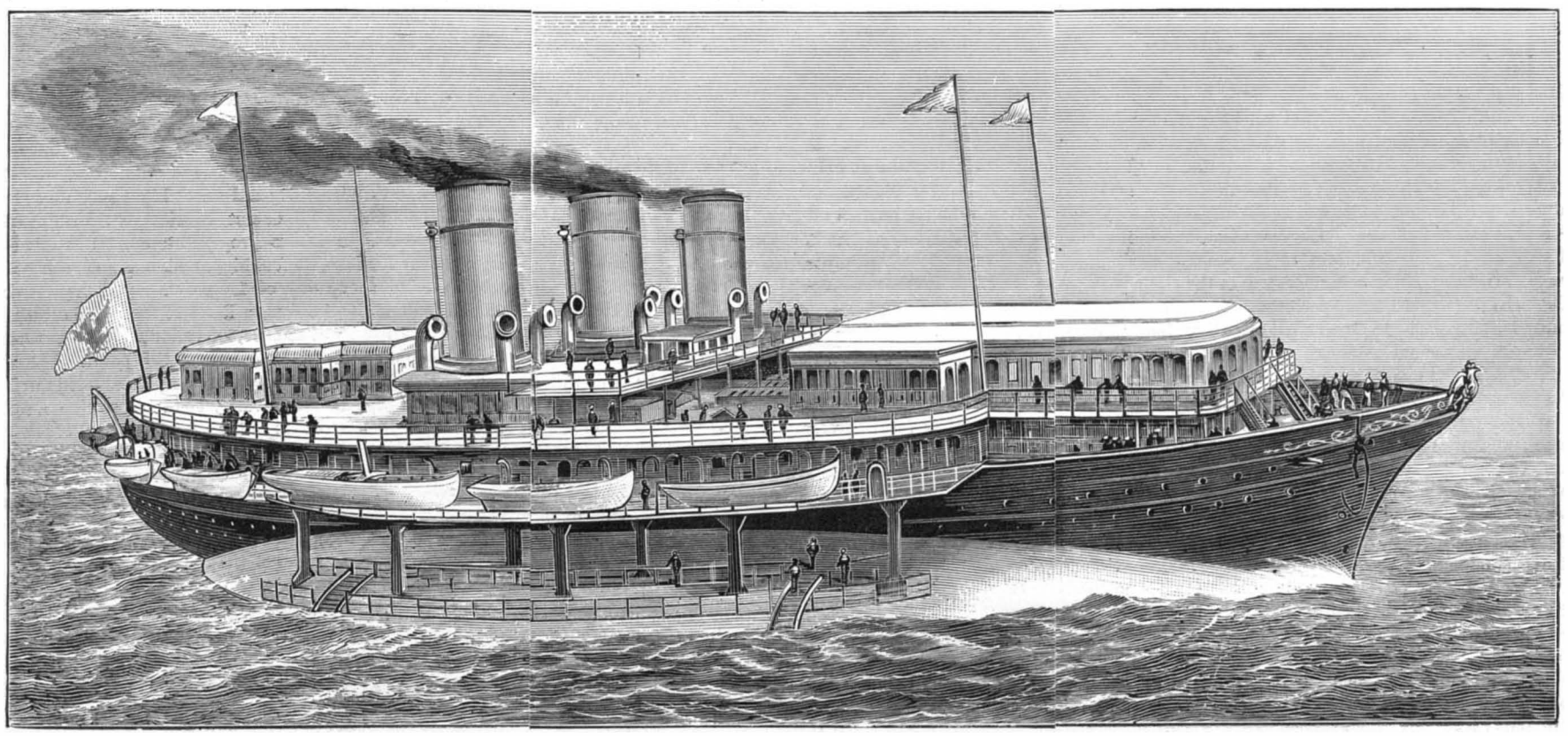
An improved beehive has been patented by Mr. Samuel Moore, of New Salem, Ill. The object of this invention is to provide a beehive with means whereby it may be thoroughly ventilated, and the bees thus always kept in a healthy and vigorous condition.

Mr. John M. Miller, of Huntsville, Ill., has patented an improved carpet stretcher, which consists in a novel arrangement of a stretching bar, a lever, and a pawl, by means of which a person can readily stretch a carpet and retain it under tension as long as may be required.

A bracket especially designed for dentists' use, which may be readily adjusted in a horizontal or vertical position, has been patented by Mr. Charles E. Kells, Jr., of New Orleans, La. The invention consists of a tube containing a spring-actuated longitudinally-moving ratchet, said tube being secured upon a plate which is pivoted to the end of two parallel arms, whose other ends are pivoted to a plate that is designed to be fixed to the wall of a room.

Messrs. Ebenezer Hathaway and Thomas H. Myers, of Hume, Ill., have patented a self-coupling coupler, by the use of which the necessity of going between the cars for the purpose of uncoupling will be avoided.

Mr. John J. Towle, of Dixfield, Me., has patented a combined foot warmer and lantern, which may be fixed in the bottom of a vehicle for the purpose of warming the feet of the occupants and for throwing light upon the road.



THE CZAR'S NEW YACHT LIVADIA.

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THE STURGEON.

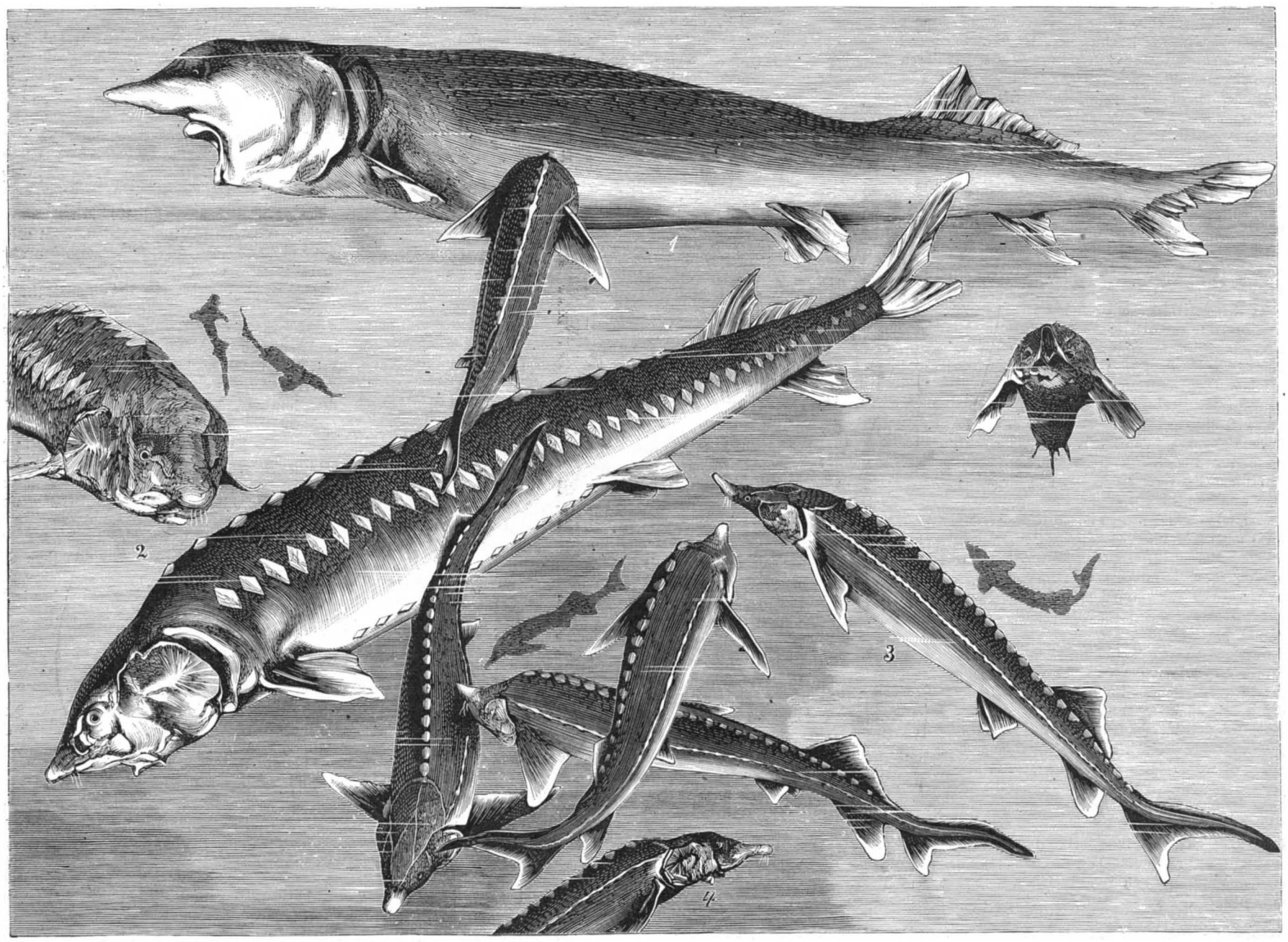
BY A. W. ROBERTS.

The most common varieties of sturgeon found in our waters are known as the sharp-nosed and the blunt-nosed sturgeon.

The sharp-nosed sturgeon (*Acipenser sturio*), so named from the fact of its snout being pointed, often attains a length of from twelve to fifteen feet and a weight of two hundred pounds. In habit it is a bottom fish, feeding on animal and vegetable substances. It is quite at home either in fresh or salt water.

The blunt-nosed sturgeon (*Acipenser brevirostris*) has a blunt, short snout, of but a quarter the length of the head. This variety is more frequently found in fresh water.

Hyde Park, some eighty-three miles up the Hudson River from New York, is one of the principal fishing stations for sturgeon (or, as it is sometimes called, "Albany beef"), whose roe, when properly prepared, is known as *caviare*, a food preparation greatly enjoyed by our German and French citizens, not to forget the Russians, to whom we export large quantities every year.



STURGEON AT THE BERLIN INTERNATIONAL FISHERIES EXHIBITION.

Of late years the take of sturgeon has fallen off steadily on account of the great increase in the number of both set and drift nets used in shad fishing, and also the greater number of vessels of all descriptions passing up and down the river, all of which scare the sturgeon from their favorite feeding and spawning grounds. Only a few years ago it was no unusual occurrence for a fisherman to take twenty and often thirty good-sized sturgeons a day, whereas now one and two a day are considered a good catch.

The fish are taken with a net varying in length from five hundred to seven hundred feet by thirty feet in depth. The net is made of heavy cotton twine well tarred, the size of the mesh being one foot. The fishermen knit their own nets. A good sturgeon net costs from $50 to $75. The anchor lines to which the net is attached are twenty feet long. Along that part of the net which is known as the "cork line" are attached from twenty to thirty wooden buoys, to show the position of the net when under water as well as to keep it in an upright position. As soon as a sturgeon butts or strikes the net with his head, or he becomes gilled in the mesh, the entire line of wooden buoys begin to dance; those directly over the gilled sturgeon disappear under the water and thus indicate exactly where to "cut-up" the net for the sturgeon. A noose is then passed over the tail of the sturgeon and he is hauled into a large flat-bottomed scow, after which he is well clubbed over the head to stop his flopping. A good sized "cow sturgeon" is worth about $5, the roe weighing about one third as much as the fish. A fifty pound roe is considered a large roe, thirty pounds being the average. A "bull" sturgeon seldom brings more than $3, and is usually cut up into steaks for smoking.

As soon as the sturgeons reach shore they are opened, and the roes taken out and conveyed in tin vessels to a very cool underground apartment built of stone, containing a cemented floor. Masses of roe are rubbed on wire sieves till each egg separates from the fatty and fibrous portion of the roe and passes through the sieve; the eggs are then placed in tin vessels and salted for a short time, after which they are laid on hair sieves to drain off. When thoroughly drained what was but a short time ago only halibut spawn, is now the toothsome *caviare*, of which thousands of pounds are annually spread on bread and eaten with much relish. After draining it is packed in barrels, each barrel containing one hundred pounds, which sells at ten cents a pound. In this country no use is made of the air bladder of the sturgeon, out of which isinglass is made in Russia.

The smoking of sturgeon is entirely in the hands of small dealers, mostly Germans in and about New York city, small lots of sturgeon and eels being smoked each day. Smoked sturgeon and eels have to be worked off rapidly, as they soon become mouldy and rancid.

I once brought a live sturgeon from Menemsha Bight, Mass., weighing one hundred and seventy-five pounds. He lived in the aquarium several weeks. When taken out of the tank dead it was discovered that his insides were gone (eaten out by other fish). How long he had lived in this condition none of the professors knew, but it was conceded that the sturgeon on the whole was a tough fish.

Duration of Vitality of Seeds.

The duration of vitality of seeds, says one of our foreign exchanges, depends upon a variety of circumstances. Under exceptional conditions, such as being buried at a considerable depth in a moderately dry soil, some seeds will retain their germinating power for an almost indefinite period; but great doubt and uncertainty attach to all the accounts of the germination of very old seeds. This remark applies to the so-called mummy wheat, said to have been raised from grain taken from an ancient Egyptian sarcophagus, and some other instances of the same nature. It is, however, not impossible that some seeds may retain their germinative force, under the exceptional conditions indicated, for a much longer period than that for which we have unimpeachable evidence. A humid atmosphere is very destructive, but exposure to a moderately dry air acts beneficially. The degree of cold a dormant embryo will bear with impunity, providing it has not been saturated with liquid, seems to be practically unlimited. Mr. Darwin and others have made experiments on seeds by immersing them in salt water. Out of eighty-seven kinds sixty-four germinated after being in salt water for twenty-eight days, and a few after an immersion of one hundred and thirty-seven days.

Instances are on record, too, of seeds of American plants, which have been washed on the shores of Western Europe, germinating after their long voyage across the Atlantic. Perfectly ripened seeds of different plants vary greatly in their germinating force; and the approximate duration of vitality of most common seeds when stored is known. Some seeds, such as those of angelica, coffee, etc., must be sown soon after they are collected; others, like those of the China aster, alder, birch, and sycamore, will rarely germinate the second year; while others retain the power for an unknown period.

Authenticated instances of seeds retaining their germinating powers for a considerable number of years are by no means numerous. Seeds of *Sida abutilon* kept in a seed warehouse for at least a quarter of a century have germinated as freely at the end of that period as when first received. M. De Candolle, in 1856, sowed seeds of three hundred and eighty-six species collected in 1831, twenty selected seeds of each sort being employed in the experiment. Only seventeen species germinated, and, of fifteen of these, only one, two, or three seeds; but fifteen out of twenty of *Dolichos unguiculatus* and six of *Lavatera* grew. Radish seed has been known to grow freely when seventeen years old, and it is also recorded that kidney beans one hundred years old, rye one hundred and forty years old, and *Mimosa pudica* sixty years old, have germinated. Probably some of these records are due to unintentional errors in the experiments. So far as experience goes, prolonged vitality seems to depend on the nature of the pericarp, testa, or albumen, though there are some inexplicable exceptions. Thus carrot will keep good four years, whereas angelica and parsnip (members of the same family), having more oily seeds, will only grow the first and second spring respectively after they are collected. The seeds of Australian acacias, which have a very hard, dense testa, are long lived, but the kidney bean, which belongs to the same family, rarely grows after the third season. Some seeds, for different reasons, are preferred two or three or more years old to quite fresh ones; in some instances because the older seed germinates more regularly as to time. Old balsam seed, other things being equal, has the reputation of yielding a larger proportion of double-flowered plants than new, because its vital force decreases with age.

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The average duration of vitality in seeds of some of our cultivated plants is as follows: Artichoke, five years; broad bean, six: beet root, five; cabbage, five; carrot, four; cucumber, five; lettuce, five; maize, two; melon, five; onion, two; parsnip, two; peas, four or five; radish, five; spinach, five; tomato, five; turnip, five; egg plant, seven; endive, nine; parsley, three; strawberry, three. An analysis of these figures shows a general agreement in the constitution of the seeds of different plants of the same families, with exceptions which can be accounted for in the way already explained. Exalbuminous seeds, and those with very little albumen, retain their vegetative power longer than seeds with a minute embryo and a relatively large quantity of albumen. Taking a broader survey, the rule holds good that the more highly developed embryo, whether small in itself or large, will lie longer dormant without losing life than the large or small embryo of albuminous seeds. Sir Joseph Hooker has stated that the seed of *Nelumbium speciosum*, taken from a herbarium known to be upwards of one hundred years old, germinated. This seed has an exceedingly dense testa.

FORMATION OF AMERICAN COAL.

The base of our coal measures is a rock, called the great conglomerate, which is chiefly composed of white, water-worn pebbles. Its composition proves it to have been the bed of an ancient sea; and that a great sea existed in the eastern half of our continent is a fact well known to geologists, who have traced it from the Rocky Mountains to the Blue Ridge. In this wide expanse of water the coal deposits of our country were formed beyond a doubt. It was a wise provision of nature to lay for their base the thick and strong conglomerate rock, as the violence of volcanic action in that early period was so great that a weaker barrier would have been broken, and the coal would have been destroyed by denudation. The 200,000 square miles of American coal are divided, by Prof. Rogers, into five great fields, of which the first, or eastern, includes the coal deposits of Newfoundland, Nova Scotia, Cape Breton, and New Brunswick. The second, or Alleghany coal field, is the largest, and extends from Pennsylvania and Ohio, southwestward, into Georgia, and includes the anthracite fields of eastern Pennsylvania. The third is a small field, known as the northern, occupying the central part of Michigan; and the fourth is the central field, including parts of Illinois, Indiana, and Kentucky. The fifth or western field, lies west of the Mississippi, principally in Iowa and Missouri, but extends into Arkansas.

Besides these well defined fields, we have, further west, the uncertain deposits of the Black Hills; but as the thickness of the American coal measures regularly decreases from east to west, the seams that may be found on the eastern slope of the Rocky Mountains must be very thin and scarcely workable. In the east, where the coal formation is thickest, there are in all about fifty seams, but not half of them are of sufficient thickness to be worked. In Nova Scotia only five are of workable dimensions, and these produce about twenty-five feet of coal. In the anthracite region, the number of productive seams is about twenty-five, and they average in some sixty feet of coal, but their maximum yield is somewhat over a hundred feet. The largest of the anthracite veins is the "Mammoth," which is thirty feet thick. In the Alleghany region the average thickness of workable seams is about half that of the anthracite fields; and in the western fields it is only about ten feet. Thus the number of seams, and the quantity of coal, decrease from east to west; as also the thickness of the intervening strata of rock. The greatest depth of the coal measures, including these strata, is 3,000 feet.

It is supposed that coal was formed during the carboniferous era, when the earth and the atmosphere were in a condition to produce an unlimited and gigantic growth of vegetation.

That the coal beds had their origin during this vast vegetable growth, is a well attested fact; but the process by which the carbon and bitumen of that rank vegetation were concentrated and solidified, is a point on which scientists differ. The fact that there is no sign of vegetation in pure coal, indicates that the component parts have been expelled by heat or pressure, in the form of oil. If accumulated vegetation or woody fiber had formed coal, it would doubtless be fossiliferous. It seems natural, therefore, that the enormous oil deposits of the carboniferous era, resulting not only from resinous vegetation, but also from the countless myriads of marine animals, when accumulated in localities having the requisite conditions, formed beds of coal. Great quantities of this oil were evidently sealed between rocky strata, and thus kept from solidifying, for want of exposure; and from these reservoirs issue the numerous oil springs of the present day. Herodotus, more than two thousand years ago, referred to a spring on one of the Ionian Islands, which is still flowing. The Chinese *Hotsing*, or wells of fire, are gaseous petroleum springs, and are made of much practical service in evaporating salt water. There is a similar spring in Fredonia, New York, south of Lake Erie, the gas of which is used for lighting the town. Genoa and Parma, in the north of Italy, are similarly lighted. In Cuba petroleum springs are very numerous; and between the fissures of rocks it has consolidated in the form of bitumen, which is used for fuel. When petroleum is thus solidified by exposure to a moderate heat, it bears a strong resemblance to bituminous coal; but under a higher temperature, the hydrogen and oxygen are evaporated, leaving a comparatively pure carbon, resembling anthracite; and when subjected to an intense heat, the carbon is also vaporized, leaving only the impurities.

The best anthracite coal contains about ninety per cent of carbon, which is rendered gaseous by the ordinary process of combustion. From these facts we may infer that the various kinds of coal are due to different degrees of heat to which they were exposed during formation. The oily cannel coal was evidently formed with little heat, the ordinary bituminous with more, while the hard anthracite was subjected to such a degree of heat as left it nearly a pure carbon.

Oil being lighter than water, it readily accumulates on the surface of lakes, and on long exposure it forms a sheet of bitumen, or pitch, which in winter is hard, so that a man can walk on it with safety. There is such a lake on the island of Trinidad, one of the West Indies; and similar lakes are known to exist in other volcanic regions. Hence, during the periods of vegetable and animal oils, and of extraordinary volcanic activity, producing, no doubt, an abundance of oil directly from mineral sources, it is reasonable to suppose that immense bodies of water were thus covered to a great depth with plastic coal. The time of such formation necessarily corresponded with a period of volcanic inactivity. While forming, the sheet may have been occasionally sprinkled with a slight shower of ashes, causing an impurity in the coal, such as slate or bone; and a rent in the sheet, caused by contraction, may account for the fact that the miner sometimes suddenly loses the vein, and must grope for it through the rock. When volcanic action revived, the greatest imaginable changes must have taken place, to account for the strata of rock overlying the seam. Between some of the seams the stratum is over two hundred feet thick. Showers of ashes or streams of lava may have sunk the sheet to the bottom, when, during the next period of inactivity, another seam may have been formed to be submerged in like manner, but perhaps with a stratum of only a few feet in thickness.

That these strata decrease in thickness from east to west, may be attributed to the well known geological fact that volcanic activity was greatest in the eastern section of our continent; and as the seams decrease in like manner, we may infer that coal owes its origin chiefly to volcanic sources.—*By Moses Zweizig, in Christian Weekly.*

PLANTS OF THE CARBONIFEROUS PERIOD.

NEW USE FOR CYPRUS REED STEMS.

Mr. John R. Jackson, of the British Museum, referring, in the *Gardener's Chronicle*, to the enormous trade now carried on in London in the manufacture of walking sticks and parasol handles, says that, notwithstanding the large number of these useful and ornamental articles that are constantly being produced, and the consequent demand for certain kinds of sticks, there is every now and then a utilization of something quite new, and different from anything that has hitherto preceded it. Such, for example, was the discovery and adaptation of the fasciated stems of the fuller's teasel, which some two years since were imported in vast numbers from France for the sole purpose of converting into parasol handles. At a recent meeting of the Linnæan Society specimens of a newly introduced cane were exhibited both in the rough and finished states. These canes were at first thought to be derived from a species of bamboo—*Bambusa nana*—and hence received the trade name of "Nana"; but it was afterwards discovered that they were from the Cyprus reed (*Arundo donax*). The peculiarity which has caused them to be taken up for the purpose to which they are now applied lies in the irregular and fantastic forms of the rhizomes, and especially in the ring-like ridges which encircle these rhizomes at regular intervals. Owing to the combined form, surface markings, and natural yellow tint, which harmonizes so well with the coverings used, a more unique handle for a parasol could hardly be produced. These articles have now become quite the rage, and may be seen in large numbers in the show windows of fashionable stores. The Cyprus reed is a robust grass, growing fifteen feet or more in height, with abundant leaves and very large terminal panicles of a brownish-white color. It is found in southern Europe, eastern Asia, and on this continent in Texas and Mexico, and is apparently the reed mentioned in Scripture. The uses to which the plant has hitherto been applied are as supports for vines, for fishing rods, etc.

Functions of the Air Bladder in Fish.

In a paper read at a recent meeting of the Cotteswold Naturalists' Field Club, by Mr. Francis Day, the author remarks that few among the organs in fishes have been the cause of so much discussion as the air bladder, which is a single or variously divided sac, situated beneath the vertebral column and the kidneys, and placed above the center of gravity. As this organ is sometimes present or absent in species of the same genus, it is evident that it is not entirely indispensable to the fish's existence. It originates as an offshoot from the stomach, elongates, and then enlarges at its extremity into what is termed an air bladder. In the dipnoids the air bladder communicates with the œsophagus during life, and its functions are analogous to those of lungs. In *Amia*, a ganoid fish, it has also a lung-like function, but in *Acipenser* it is used merely for hydrostatic purposes. The air bladders, however, are not considered as lungs in most fishes, since the blood is supplied to them from the adjacent arteries, and in many cases returns as venous blood into the circulation. In *Lepidosiren*, however, in consequence of the non-development of gills on the two inferior branchial arches, the blood is not arterialized there, but passes on to the air bladder for this purpose. The lepidosirens are doubtless the highest known form of living fishes. The chief use of the air bladder in teleostean fishes is (1) hydrostatic; (2) acoustic, it being partially or entirely employed for hearing by means of various modes of connection with the internal ear.

In the *Physostomi* the air bladder occurs as a closed sac. In the marine forms of these orders a tubular prolongation itself passes forward to the anterior portion of the skull to establish an auditory communication, but in the fresh water species the connection is formed by a chain of auditory ossicles. In conclusion, Mr. Day says that the air bladders in fishes is the homologue of the superior vertebrate forms, and that in some of the higher sub-classes it serves as an accessory respiratory organ.

Amplifying Small Motions.

At a recent meeting of the London Physical Society Mr. Ridout exhibited a device for amplifying small motions. A small barrel is slung by two threads between the prongs of a metal fork in such a manner that if the fork is bodily carried to and fro the barrels will rotate round its axis. This is simply effected by making each thread, in its passage from one prong to the other, take a few turns round the barrel. To the barrel an index is attached, and the fork is then fixed on the body whose minute motion is to be indicated. The translation of the body shifts the fork and rotates the barrel, which in turn deflects the index round the face of a dial, and the magnifying power is expressed by the ratio of the diameter of the barrel to the length of the index. With this apparatus Mr. Ridout exhibited the lengthening of an iron core when magnetized by the passage of the current of two Grove's cells through an insulated wire coiled round it. By riveting a slip of brass to the iron the unequal expansion of brass and iron under heat was also shown, the heat being generated by keeping the current flowing in the coil.

Mr. D. Winstanley exhibited his new radiograph for recording graphically the intensity of solar radiation throughout the day. It consists of a differential thermometer, with one black bulb and a circular stem. The lower part of the stem is filled with mercury; the upper branches with sulphuric acid and water. The tube is mounted on a brass wheel, so that when the black bulb is exposed to the sun's rays the differential motion of the mercury causes the wheel to turn. The wheel carries a light index or marker, which is free to traverse a vertical cylinder covered with paper coated with lamp-black, and leaves a white track where its point has scratched off the soot. The radiogram thus produced can be fixed and preserved.

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Dr. Guthrie pointed out the curious "thermal twilight" these radiograms had betrayed to Mr. Winstanley. They show that before sunrise the temperature increases, owing to solar radiation. Moreover, half an hour after sunset the index falls, and remains till within a few minutes of midnight, when it mysteriously rises and sinks again, although the sun is then directly over the opposite hemisphere.

History and Progress of American Water Works.

The first works in America for the supply of water to towns were constructed by Hans Christopher Christiansen, and put in operation June 20, 1754, at the Moravian settlement of Bethlehem, in Pensylvania.

The water from a spring, which is still used for the supply, was forced by a pump of lignum vitæ of five inches bore, through hemlock logs into a wooden reservoir.

The same ingenious Dane, eight years later, replaced this rude pump by three iron pumps of four inches bore and eighteen inches stroke, which for many years were the only machinery for water supply on the continent, and for seventy years furnished the water for Bethlehem.

Among the oldest, if not the very next in date to Bethlehem, is the Morristown, N. J., Water Company, which was incorporated in 1791, and has ever since furnished the town with water collected from the neighboring hills.

The first application of steam to pumping was in Philadelphia, in 1800, when the third steam engine of any considerable size in the United States was erected on the banks of the Schuylkill. It is believed that these works were the first constructed by a municipality. The first cast iron water pipes were laid in Philadelphia in 1804.

New York was first supplied by a company which erected a small pumping engine about 1800.

During the first thirty years of the century several small works were constructed, among others, at Cincinnati, in 1817; at Detroit, in 1827; at Lynchburg, in 1828; Syracuse, in 1829; and Richmond, in 1830. Few of these works exhibited any great advance in engineering. The enlarged works for the supply of Philadelphia by water power, constructed at Fairmount, in 1822, showed, however, a marked advance, and were for many years regarded as a model of efficient and economical works. The design and execution of the gravity supply works for New York and Boston, between 1830 and 1840, were such as cannot be greatly improved, even at the present day, except in some minor details.

About 1850 the substitution of light wrought iron pipe, lined inside and out with hydraulic cement, for cast iron, at greatly reduced cost, was found to be practicable in many cases, and the formation of companies to manufacture and lay such pipes, introduced a commercial element into the matter of water supply, and led to the construction of many works.

Improved forms of pumping machinery, which performed a fair duty at small expense for construction and maintenance, were designed and their manufacture became a special business.

The careful analysis and investigation employed in the construction of the works for the supply of Brooklyn, between 1850 and 1860, resulted in a more decided advance, in both theoretical and practical science, than had hitherto been made, the effects of which were seen during the succeeding decade in improvements in pipe manufacture, in engine building, in reservoir construction, and in maintenance of works.

Between 1860 and 1870 a further impetus to water works construction was given by the vigorous prosecution of an enterprise for building entire works for direct supply, by pumping into the mains without the intervention of a reservoir. The success attending this enterprise, owing to the small first cost of construction and to shrewd management, created competition, the result of which has been to force the adoption of scientific methods and the employment of skilled engineers, and as a consequence there has been great improvement in the types of machinery and in economical working.

The pumping machinery of large cities has also been greatly improved; the duty now required, and uniformly maintained, being at least fifty per cent greater than it was thought possible to obtain twenty years ago, or than is now furnished by the less costly "commercial engines," of which two firms alone have built 242 for 168 towns, with an aggregate pumping capacity of 734 millions of gallons per day.

The construction by Mr. Chesbrough of a submarine tunnel for two miles under Lake Michigan, to furnish water for Chicago, was one of the boldest engineering feats of this century. Its successful completion was followed by the construction of several similar works.

On the Pacific coast the use of unprotected wrought iron pipe for conveying water great distances, and under great pressure, has proved very successful.

During the past ten years the most important work executed has been the enlargement of the gravity supply for Boston, by the construction of a conduit of masonry, in the designing and erection of which the latest and most perfect methods have been followed. The subjects to which particular attention has been paid by engineers during this period have been the efficiency of pumping machinery, the capacity of gathering grounds, the preservation of the purity of the water, and the prevention of waste by consumers.

All American works are constructed for a constant supply, and most of those first built had a capacity far in excess of the then demand, which caused the formation of habits of wastefulness, which it has been found difficult to check when the limit of the capacity was nearly reached.

The magnitude of the interests involved in this branch of engineering may be judged from the fact that there are now in the United States and Canada 569 towns with a public water supply, having a population of about 12,000,000, to whom there are daily distributed over 600,000,000 of gallons of water, through 13,000 miles of pipes, of which about 10,000 miles are of cast iron.

About one-half of these towns are supplied by gravity, many of them, however, having supplemental pumping power, the total capacity of the pumping engines now in use being about 1,900 millions of gallons per day.

Meanwhile improvements in plumbing and house distribution have greatly added to the convenience about our homes, and we now virtually have a spring of cold and another of hot water in almost every room of our city houses to put on tap at will.—*O. Chanute.*

Printing Exhibits.

An interesting exhibition has lately taken place at Agricultural Hall, London, of printing and book machinery, stationery, etc. Among the exhibits the proprietors of the *Daily Chronicle* have on their stand, besides a variety of raw materials and paper stuff, a large roll of paper such as is used in their printing works, but of exceptional dimensions, to show the capacity of paper-making machinery. This roll contains an endless band of paper 110 inches wide and about 5 miles long, and is manufactured on a machine made by Messrs. G. & W. Bertram, of Edinburgh, the rolls of which are 125 inches wide, and it is said to be the largest paper-making machine in the world.

The Lanham Printing Roller Company have on their stand a number of their patent India-rubber rollers, and among them some ink rollers of large size, which have been in daily use on one of the Hoe American printing machines at the London *Daily Telegraph* for over two years, and still appear in excellent condition. These rollers have a solid rubber surface about ¼ inch thick; below this an additional amount of elasticity for special purposes is obtained by casting thin iron rods, about ¼ inch in diameter, at about $\frac{1}{16}$ inch pitch all round into the rubber, and drawing them afterward, leaving holes through the length of roller. The total India-rubber thickness of these rollers is about ⅝ inch, and this shell is fixed over an inner core. To insure perfectly true running, the rollers are carefully turned, and this operation can be repeated should their surface become worn. This, however, appears to be necessary only after very hard wear, and though the rubber rollers are no doubt expensive in first cost, they repay themselves by their reliability and durability.

Messrs. Waterlow & Sons, of London Wall, show a large group of miscellaneous exhibits, among others a stylographic pen, an American device recently introduced into England. It is an admirable specimen of workmanship, and is very ingeniously designed. The handle of the pen is also the ink reservoir, but it contains besides, a hollow stem projecting beyond the lower end of the handle into the cover which terminates in the writing point. The upper end of the stem is open to the air, but is closed with a screw cap that covers a small hole admitting air into the stem. To the lower end of the latter a light spiral gold spring is attached, carrying at its outer end a fine iridium-tipped needle point. This needle is protected by the cover which screws into the stem, and which terminates in a hollow iridium point, through which the end of the needle projects slightly and plays up and down as the point of the pen is passed over the paper, every slight motion of the point pumping down a small supply of ink, while air enters from the top of the pen down the stem already mentioned, and through a small hole at the foot of the stem. The point is protected by a cap, which is fitted on to the top of the handle when the pen is in use. These pens, says *Engineering*, are all of American manufacture, and we doubt whether it would be possible in this country to produce so well-finished a combination of vulcanite and metal.

Chemical Manufactures in Philadelphia.

One of the great industries of Philadelphia is the manufacture of chemicals, or of articles for the production of which chemical processes are necessary. Many of these take the form of drugs and medicines for the wholesale trade, not including specifics. Others are acids, alkalies, and chemical agents used in other manufactures. White lead and chemical paints are also included. The line of distinction is not easy to define to the general reader, though well recognized in the trade, and it does not include the body of products known as dyes, paints, and medicines, although closely related to them. As so defined, the chemical manufacture in Philadelphia includes, says the *Public Ledger*, about thirty establishments, whose annual product has risen from $6,152,380 in 1870, to $10,000,000 in 1875, and $12,000,000 in 1877, and, as nearly as may now be calculated, about $12,000,000 in value for the year just closed. They give employment to about 2,000 persons—a relatively small number for the values produced—and have attained a position of supremacy in their respective departments which renders them reasonably secure. The drug and medicinal products are the largest, eight or ten establishments producing $8,000,000 in value of quinine, morphia, preparations of iodine, bromine, etc., with other standard pharmaceutical preparations. These are now the basis and body of applied pharmacy in this country, and are likely to increase even more rapidly in the future. On the side of standard medicines used as specifics almost as much more would be added, and the classification would be entirely appropriate as a manufacture. The drug and chemical works insist on the distinction, however, and in a calculation of a total of $12,000,000 production they are not included. They would reach $6,000,000 at least, and under the general name of proprietary medicines, footed a total of $5,490,105 in 1870.

Progress of Railways in Texas.

Ex-Governor John C. Brown, Vice-President of the Texas and Pacific Railway, tells the *World* that the progress of the road is now very rapid. Already the line approaches the Brazos River, and by the end of the current year it will have 150 miles or more of track beyond that point. The region is remarkably fertile, and is rapidly filling up with population. Several other important railway operations are being vigorously forwarded in Texas.

Among these is the extension on the Texas and Houston Central westward from Waco to Eastland City. There it makes a junction with the extension of the Texas and Pacific Railroad Company; the extension of the Gulf, Colorado, and Santa Fé road northward and toward Fort Worth or Dallas; the extension of the transcontinental branch of the Texas and Pacific Company Railway line from Sherman to Whitesboro and thence to Denton; the early extension of the Dallas and Wichita to Denton, to connect with the extension from Sherman. A new line from Dallas toward Sabine Pass is being pushed forward under auspices which promise an early construction of the line, which will be most important to the enterprising and growing city of Dallas, and will be a very important feeder to the two trunk lines which cross each other in that city. This line will connect southeastern Texas with the great West and Northwest, and tapping as it does the vast forests of long-leafed pine and red cypress will transport to the prairie countries the products of these forests, which, while this carriage will be a very large source of profit to the lines over which they are conveyed, will furnish cheap lumber to the region of country west of Dallas, which is very rapidly filling up with population and is one of the most productive agricultural sections in the world. From Austin, the capital of Texas, to San Antonio, the most important city in the southwestern part of the State, the International Railroad is being constructed, and it is believed by many that either that line or the one known as the "Sunset Line" will be pushed rapidly to the border of Texas at Laredo or some other point on the Rio Grande.

There are also a number of narrow gauge roads in various parts of the State being rapidly built; among which may be mentioned one from Corpus Christi which follows up the valleys of the Nueces and the Rio Grande; the east line from Jefferson, which is now extended to Sulphur Springs, and is being pushed rapidly west by the way of Greenville and McKinney; the Texas and St. Louis from Texarakana by way of Tyler and Corsican, in the direction of Waco and beyond. Another and perhaps the longest line of narrow gauge in the State, is the one from Houston, known as the Bremonde road, running northeastwardly in the direction of Marshall and Shreveport. There is another railroad enterprise on foot which has been reorganized and promises an early commencement of work from Dallas to Cleburne among the richest and most populous communities in the State.

The Iron Capacity of the United States.

Speaking of the failure of the Vulcan Iron and Nail Works at Chattanooga, *Capital and Labor*, of England, says: "The failure of one remote mill at the present juncture means, perhaps, very little; but throughout the United States many works are reported unemployed, not because there is no demand, but because *the production of raw iron in the United States is really inadequate if America has any pretensions at all to the ability to supply her own needs in respect to raw material.*" These comments exhibit singular ignorance of the iron industry of the United States. The truth is, the blast furnace capacity of the United States is more than sufficient to supply the demand, as shown by the fact that a great many of them have been idle for six or seven years.

The *Enquirer*, on the other hand, "hits the nail on the head" squarely. In a lengthy editorial, besides other facts, it gives utterance to the following: "The United States have at the present moment a great deal more iron than they can possibly use, and *facilities for producing at any time more iron than they want*—always provided that the consumer does not insist in having supplied to him in any one year as much iron and steel as he can use in two years." This, says the *American Manufacturer*, is an undeniable truth most happily stated. It was this singular greed of consumers that led to the heavy importation of iron during the last ten or twelve months, and not the inability of our manufacturers to supply all the iron the country needed.

Expansion of Glass.

The expansion of glass by heat may be demonstrated as follows: A glass tube of narrow bore and about eighteen inches long is bent round in the shape of a horseshoe, so that the free ends are within a millimeter of one another. Between these ends a coin may be held, being nipped between the ends of the rod and held there by the grasp due to the elasticity of the glass. If now the *outer* portion of the curved part be warmed, the ends open slightly and the coin drops out. This experiment is due to the ingenuity of Mr. Ridout.

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RECENT DECISIONS RELATING TO PATENTS.

United States Circuit Court.—District of Minnesota.

PATENT FOR CORRUGATED IRON FOR BUILDINGS.—BELT *vs.* CRITTENDEN.

The complainant is the assignee of the letters patent granted to F. E. Perkins, May 30, 1876, for improvement in metal coverings for buildings.

The claim is:

A metallic covering for wooden structures, composed of the metal sheets, B, applied to the surface of the structure in the manner shown, whereby an air space is left between the metal sheets and the wall or structure at all points, except at the edges of the sheets, substantially as and for the purpose set forth.

Nelson, J.:

The defendant's witnesses, upon the defense of novelty, refer to several forms of corrugated iron previously used, and all would fill the specification and claim made by the complainant. The fact that the iron at the point of contact with the wood is double in thickness, or that the nail holes at the joints may be made elongated in order not to interfere with the nails in case of expansion or contraction lengthwise of the corrugations, will not sustain the patent; nor will his manner of forming the joints connecting the several sections of sheathing aid him. There is no novelty in the latter.

The bill is dismissed, with costs.

United States Circuit Court.—Northern District of New York.

PATENT HAY RAKE.—WISNER *vs.* GRANT *et al.*

Wallace, J.:

1. Claims 1, 2, and 4 of reissued letters patent granted to William H. Field, November 5, 1878, for an improvement in horse hay rakes, held to be substantially anticipated by the patent granted H. W. Sabin, December 3, 1850.

2. Where the office of a reissue was to secure a broad claim the complainant in a suit upon such claim must be held thereto, even though the real invention is not secured thereby.

United States Circuit Court.—Southern District of New York.

MCDONALD *vs.* SIDENBERG *et al.*

The construction given by the court in the case of McDonald *vs.* Shepherd to the patent granted to Helen M. McDonald, September 29, 1874, for an improvement in skirt protectors, approved.

Helen M. McDonald for herself. Mr. E. N. Dickerson for the defendants.

Blatchford, J.:

The defendant's article in the present case does not have a fluted or plaited border, but it is like the plaintiff's article in all other respects. I concur with Judge Lowell in not regarding the fluted or plaited border as essential, in view of the state of the art prior to the plaintiff's invention in December, 1861. The affidavits presented by the defendant in the present case do not show any article anticipating that date like the plaintiff's invention, whether with or without a fluted or plaited border. T. D. Day gives no date earlier than 1865. The article of 1858, which J. Morrison speaks of, was only a facing. His entire affidavit is too vague and general. H. Douglass, as to a skirt protector of enameled cloth over a facing, gives, as a date, "as early as 1861." This is not sufficient. R. Hood goes back only to 1865.

An injunction is granted.

New Method of Precipitating Rain Falls.

Among the recent patents is one taken out by Daniel Ruggles, of Fredericksburg, Va., for what he designates as a new and useful mode of producing rain or precipitating rain falls from rain clouds, for the purpose of sustaining vegetation and for protection against drought and for sanitary purposes.

The invention consists in sending balloons into the cloud realms, said balloons carrying torpedoes and cartridges charged with explosives, and there to explode or detonate them by electric force.

"My design," he says, "is to employ every kind of explosive force at an elevation in the cloud region of the atmosphere, in order to condense rain clouds by concussive force or the power of explosion within such region, thereby precipitating rain to sustain vegetation, prevent drought, and also purify and renovate the atmosphere during periods of pestilence and epidemics.

"I contemplate the employment of nitro-glycerine, dynamite, chlorates of nitrogen, gun cotton, gunpowder, fulminates, and other explosives, and to use the magneto-electric telegraph on the surface of the ground and the phono-telegraph in the cloud realm to direct action in cases where a regular balloon not charged with explosives is occupied by an aeronaut to reconnoiter the cloud realm, to trail torpedoes and cartridges, or to throw them in parachutes, and to explode or detonate them either from the balloon occupied by the aeronaut or from the ground.

"Instead of a single balloon provided with explosives—say ten small torpedoes or cartridges, each charged with a half pound of dynamite, and arranged for simultaneous magneto-electric explosion—I propose in some cases the employment of small balloons in groups in the cloud region, each provided with explosives and arranged for simultaneous explosion or detonation by either electric or mechanical force; and I contemplate not only to precipitate rain fall, but also to check its fall in overabundance in a given locality by causing the rain clouds to discharge rain before the given locality has been reached by such clouds.

"My invention is based on discoveries in meteorological science, and that electrical force sways and controls the atmospheric realm and governs the movements of the rain clouds, bursting into thunderstorms, dispensing rain and hail, and into cyclones and tornadoes illuminated by magneto-electric forces as prime attributes of matter.

"I propose to employ the magneto-electric engine to send explosives into the cloud realm, and compressed air and steam into the atmosphere whenever found expedient, each through its appropriate medium of metallic wire, textile fiber, cordage, and elastic tubes."

AGRICULTURAL INVENTIONS.

In cutting grass or grain, more especially if it be heavy, much trouble, annoyance, labor, delay, and expense are entailed by the obstruction offered by the grass or grain previously cut and lying in the previous swath, since it tends to clog the cutter, and thus renders its operation difficult or imperfect, or arrests it altogether. By moving the grass or grain thus cut away from the standing grass or grain the machine has a clear track, so that the cutter bar can operate with freedom and without danger of becoming clogged. Mr. William Prindle, of Santa Clara, Cal., has patented a track clearer adapted to perform this function; and it is embodied in a certain construction and combination of tubes, rods, and other parts, forming an adjustable skeleton frame.

Elizabeth Dark, Davis Collins, and George W. Nelson, of Quitman, Mo., have patented a combined harrow, marker, and cultivator, so constructed as to harrow the ground and at the same time mark it for planting, and also to cultivate the plants. It is simple, convenient, and not liable to get out of order.

Mr. Edward M. Hand, of Fredericksburg, Iowa, has patented a device for collecting manure from various points and conveying it to a compost heap or a wagon or other place of deposit. It consists in a novel rake and the combination therewith of two hinged curved arms connected to a draught bar, and two pivoted straight arms serving as handles, whereby provision is made for adjusting the rake to different positions and for tilting it to discharge the load.

An improved rotary plow has been patented by Mr. Thomas J. Tally, of Rockport, Texas. This plow is designed for plowing land, preparing the land to receive the seed, and cultivating the plants. It is convenient, effective, and not liable to get out of order.

A fence that will effectually prevent cattle, fowls, dogs, etc., from passing into the field it surrounds, and which will also be strong and durable, has been patented by Mr. John Vance, of Forest, Ontario, Canada.

Ancient American Giants.

The Rev. Stephen Bowers notes, in the *Kansas City Review of Science*, the opening of an interesting mound in Brush Creek Township, Ohio. The mound was opened by the Historical Society of the township, under the immediate supervision of Dr. J. F. Everhart, of Zanesville. It measured sixty-four by thirty-five feet at the summit, gradually sloping in every direction, and was eight feet in height. There was found in it a sort of clay coffin including the skeleton of a woman measuring eight feet in length. Within this coffin was found also the skeleton of a child about three and a half feet in length, and an image that crumbled when exposed to the atmosphere. In another grave was found the skeleton of a man and woman, the former measuring nine and the latter eight feet in length. In a third grave occurred two other skeletons, male and female, measuring respectively nine feet four inches and eight feet. Seven other skeletons were found in the mound, the smallest of which measured eight feet, while others reached the enormous length of ten feet. They were buried singly, or each in separate graves. Resting against one of the coffins was an engraved stone tablet (now in Cincinnati), from the characters on which Dr. Everhart and Mr. Bowers are led to conclude that this giant race were sun worshipers.

Spiral Energy.

At a recent meeting of the London Physical Society, Dr. Shettle read a paper "On the Influence of Solar Radiation on the Earth's Rotation." The fact established by Dr. Shettle, that the magnetic energy of a bar magnet acts along spiral lines, has led him to surmise that the energy emanating from the sun and impinging on the earth on the zone of the ecliptic traverses the earth in a spiral path, and finally emerges at the magnetic poles. The spiral of energy is "right-handed" at one pole and "left-handed" at the other, like the magnetic force in a magnet, and the electric discharge in Crookes' vacuum tubes. Like to precession and nutation these spiral paths are constantly changing and producing magnetic variations. He therefore infers that the magnetic poles will complete a cycle corresponding to the period of precession. Dr. Shettle thinks that bodies exhibit magnetic properties in proportion as they change the direction of the energy traversing them, and throw it into the spiral form. Terrestrial magnetism would be due to the solar radiance. On this hypothesis gravity would also be produced; so, likewise, would the earth's rotation (by a kind of "magnetic whirl"), electricity, tornadoes, cyclones, water-spouts, and whirlwinds. Moreover, this "spiral energy" would seem to operate throughout the whole universe.

THE GEOLOGICAL HISTORY OF THE CATSKILLS.

In an article on the Physical Structure and Hypsometry of the Catskill Mountains, in the current number of the *American Journal of Science and Arts*, Professor Guyot states that the masses of rocks forming the Catskill Mountains were deposited in a gulf of the Devonian Sea comprised between the Adirondack plateau and the Green Mountain range, including the low silurian ridges between the Hudson and the foot of the Catskills, all of which were probably emerged when the Devonian age began. Most of New England was also above the level of the ocean. The thickness of the sediments shows that the bottom of this gulf gradually subsided during that time to a depth of some 5,000 feet, constantly making room for new deposits. The presence of the gray conglomerate capping the highest hills proves that the deposition of these sediments continued into the subcarboniferous period, after which they were upheaved above the level of the ocean before the deposit of the coal measures, and have remained emerged ever since, The slight southward dip indicates that during the Devonian age a general and gradual rise of the continent took place from the north, which raised successively above water parts of the lower and upper silurian in the Helderberg and Oriskany sandstone, which were laid dry when the Catskill sandstones and shales were still depositing. The most notnotable upheaval of the Catskill region probably took place at the time of the great revolution which raised the main Appalachian system; doubled the size of the early continent, and closed the carboniferous age. But the peculiar situation which sheltered it from the immediate effect of the force which was in play, the lateral pressure arising from the sinking of the bed of the Atlantic, modified the hypsometric form of that portion of the western plateaus. When this great Appalachian upheaval began, the domain of the Catskills was secluded from the ocean by large tracts of the pre-existing lands; the Adirondack plateau on the north, New England, and the Green Mountain ranges on the east, which, though affected themselves in a measure, served as a barrier against a strong action of the upheaving force from those quarters on the region beyond.

Farther south, however, no obstacle intervening, the force was free to display its full power; and to this cause Professor Guyot is inclined to attribute not only the folding of the numerous Appalachian chains, but also the remarkable bend westward of the whole system, in Pennsylvania, as well as the significant fact that it is in the prolongation of the axis of that convexity that the western plateaus beyond swell to their greatest average height in the region of the sources of the Susquehanna, Alleghany, and Genesee rivers. To this pushing northwest and northward of the land, and its reflex action northeastward, the swelling of the plateaus of western New York may be in great measure attributed. The Catskills would thus have been subjected to a pushing action, from three or four opposite directions, by the rising lands—from the Adirondack plateau on the north, from the Green Mountains on the east, and from the rising Appalachians on the southeast and south; and hence, perhaps, their superior elevation above all the surrounding lands. On the other hand, it might be supposed that the covering of the hard subcarboniferous conglomerate, which must have been general in the Catskills, protecting the underlying strata of the Catskill formation against denudation, prevented their being swept away, as in the surrounding region, and thus preserved, in a great measure, their primitive elevation. But the known facts hardly warrant more than a surmise. The Hudson River valley during the Champlain Epoch of the Quaternary age was an arm of the sea. The last end of the Catskills was then a series of high marine bluffs, worn out by the action of the waves, and this would explain the abruptness of their eastern termination.

Eighty Square Miles of Turtles.

The Galveston *News*, of June 29, reports that between Sabine and Calcasieu, in the Gulf of Mexico, June 22, the schooner James Andrews encountered a vast multitude of green turtles, many of them very large, and all of them on their backs. Captain J. B. Rodgers, owner of the schooner, states that the schooner was lying on and off, and from observation it was estimated that the water covered by these turtles formed an area of eight miles in width and ten miles in length. They were all sizes, and not one being seen in a natural position. The water was literally covered with them. During the passage among the turtles, Spanish mackerel were leaping high in the air in every direction, as if determined to escape from the sea, giving evidence that either the water underneath was in a dreadful commotion or the sea monsters had come down on them from some strange sea. Captain Rodgers is anxious to have nautical men explain these odd phenomena of the turtles on their backs and the excitement among the mackerel. During his nautical career he never saw anything similar to it, nor did he ever before lay eyes on as many turtles and Spanish mackerel.

Electricity Affected by a Magnet.

The phenomenon lately discovered by Hall of the action of a magnet in altering the path of a current of electricity in the conductor which carries it, has formed the starting point for two investigations, which have appeared separately in the *Wiener Anzeiger*, by Boltzmann and Von Ettingshausen respectively, in which they point out that this discovery may be applied to determine the absolute velocity of electricity in a conductor.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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Belting wanted, single or double, 80 ft. 28 in.; 65 ft. 24 in.; 52 ft. 16 in.; 42 ft. 20 in.; 37 ft. 8 in. State particulars, price, condition, etc. E. A. Galindo & Co., 40 Dey St., New York city.

Hotchkiss Improved Mechanical Boiler Cleaner. Removes all sediment from steam boilers, thereby preventing incrustation. Send for circular. Jas. F. Hotchkiss, 84 John St., New York.

Superintendent wanted, well skilled in use of woodworking machinery. Address Skill, Box 773, New York.

Position wanted as Chemist or Assayer in a Chemical or Manufacturing establishment or Smelting works, by a graduate of School of Mines, Columbia College. Best of New York city references. Address A. Meissner, 98 William St., New York.

Rubber Hose, Emery, Baxter Wrench, and Soapstone Packing. Greene, Tweed & Co., 118 Chambers St., N. Y.

Rules for Engineers and Firemen, and the Removal of Scale in Boilers. Send for circular. Rankin & Co., 50 Federal St., Boston.

The $4 Drill Chuck sent free on receipt of price. A. F. Cushman, Hartford, Conn.

Wanted—Parties with Capital to Manufacture on Royalty, or other ways, a patented new Musical Instrument, consisting of sixty-six bells, piano key-board and pedals. Send stamp; full particulars will be given. Good references. Address patentee, C. G. Buttkereit, Des Moines, Iowa.

Books relating to Architecture, Civil Engineering, Electricity, Electric Light, Drawing, Gas, Heat, Hydraulics, Mining, Sanitary Engineering, Steam Engine, Turning, Water Supply, etc. Catalogues free. E. & F. N. Spon, 446 Broome St., New York.

Alden Ore Crushers and Pulverizers, six sizes, $45 to $1,500. E. T. Copeland, 30 Cortlandt St., N. Y. city.

Saw Mill Machinery. Stearns Mfg. Co. See p. 77.

See Stockwell Screw and Machine Co.'s adv., p. 76.

For Best Quality Brass and Composition Castings, address E. Stebbins Mfg. Co., Brightwood, Mass.

For Sale.—A N. Y. Steam Engine Co. 21 inch heavy Slotter, in good order. Address Southwark Fo. & M. Co., Phila., Pa.

Telephones repaired, parts of same for sale. Send stamp for circulars. P. O. Box 205, Jersey City, N. J.

Asbestos Board, Packing, Gaskets, Fibers, Asbestos Materials for Steam & Building Purposes. Boiler & Pipe Covering, Asbestos Pat. Fiber Co., limited, 194 B'way, N. Y.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole m'f'rs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Apply to J. H. Blaisdell for all kinds of Wood and Iron Working Machinery. 107 Liberty St., New York. Send for illustrated catalogue.

Our new Stylographic Pen (just patented), having the duplex interchangeable point section, is the very latest improvement. The Stylographic Pen Co., Room 13, 169 Broadway, N. Y.

Safety Linen Hose for Warehouses, Steamboats, and Hotels, at reduced rates. Greene, Tweed & Co., N. Y.

Advertising of all kinds in all American Newspapers. Special lists free. Address E. N. Freshman & Bros., Cincinnati, O.

Skinner & Wood, Erie, Pa., Portable and Stationary Engines, are full of orders, and withdraw their illustrated advertisement. Send for their new circulars.

Sweetland & Co., 126 Union St., New Haven, Conn., manufacture the Sweetland Combination Chuck.

Power, Foot, and Hand Presses for Metal Workers. Lowest prices. Peerless Punch & Shear Co., 52 Dey St., N. Y.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

For the best Stave, Barrel, Keg, and Hogshead Machinery, address H. A. Crossley, Cleveland, Ohio.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

Instruction in Steam and Mechanical Engineering. A thorough practical education, and a desirable situation as soon as competent, can be obtained at the National Institute of Steam Engineering, Bridgeport, Conn. For particulars, send for pamphlet.

Hydraulic Jacks, Presses and Pumps. Polishing and Buffing Machinery. Patent Punches, Shears, etc. E. Lyon & Co., 470 Grand St., New York.

4 to 40 H. P. Steam Engines. See adv. p. 63.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Sheet Metal Presses. Ferracute Co., Bridgeton, N. J.

Burgess' Non-conductor for Heated Surfaces: easily applied, efficient, and inexpensive. Applicable to plain or curved surfaces, pipes, elbows, and valves. See p. 284.

Eclipse Portable Engine. See illustrated adv., p. 62.

For best low price Planer and Matcher, and latest improved Sash, Door, and Blind Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

Peck's Patent Drop Press. See adv., page 76.

Special Wood-Working Machinery of every variety. Levi Houston, Montgomery, Pa. See ad. page 77.

Blake "Lion and Eagle" Imp'd Crusher. See p. 77.

Improved Solid Emery Wheels and Machinery, Automatic Knife Grinders, Portable Chuck Jaws. *Important*, that users should have prices of these first class goods. American Twist Drill Co., Meredithville, N. H.

Wanted—First-class Iron Lathe, 20 to 24 in. swing, 17 to 20 ft. bed. Wm. Anderson, 23d and Wood St., Phila.

For Standard Turbine, see last or next number.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'f'rs, 23d St., above Race, Phila., Pa.

Diamond Planers. J. Dickinson, 64 Nassau St., N. Y.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

$400 Vertical Engine, 30 H. P. See page 93.

Wanted—The address of 40,000 Sawyers and Lumbermen for a copy of Emerson's Hand Book of Saws. New edition 1880. Over 100 illustrations and pages of valuable information. Emerson, Smith & Co., Beaver Falls, Pa.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 93.

For Wood-Working Machinery, see illus. adv. p. 93.

For Separators, Farm & Vertical Engines, see adv. p. 93.

Elevators, Freight and Passenger, Shafting, Pulleys and Hangers. L. S. Graves & Son, Rochester, N. Y.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 92.

For Patent Shapers and Planers, see ills. adv. p. 93.

Steam Engines; Eclipse Safety Sectional Boiler. Lambertville Iron Works, Lambertville, N. J. See ad. p. 413.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 93.

Patent Steam Cranes. See illus. adv., page 92.

Hydraulic Cylinders, Wheels, and Pinions, Machinery Castings; all kinds; strong and durable; and easily worked. Tensile strength not less than 65,000 lbs. to square in. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 93.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 93.

C. J. Pitt & Co., Show Case Manufacturers, 226 Canal St., New York. Orders promptly attended to. Send for illustrated catalogue with prices.

Catechism of the Locomotive, 625 pages, 250 engravings. The most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for a catalogue of railroad books. The Railroad Gazette, 73 Broadway, New York.

Elevators.—Stokes & Parrish, Phila., Pa. See p. 94.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Large knife work a specialty. Also manufacturers of Soloman's Parallel Vise. Taylor, Stiles & Co., Riegelsville, N. J.

Penfield (Pulley) Blocks, Lockport, N.Y. See ad. p. 92.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) G. H. M. writes: I have a photo-negative from which I wish to print pictures. I have done such work before, but have forgotten the strength of the solutions. Of what strength should the silver solution be? Of what strength the gold and hypo? How should the pictures be washed? and should the face of the negative be covered with tissue paper? Are the pictures soaked in any solution before putting them in the toning solution? A. Sensitizing bath, nitrate of silver, 5 drachms; water (distilled), 5 oz.; nitric acid, 2 drops; pure kaolin, 1 oz. Dissolve the silver nitrate, agitate with the kaolin, let settle, and use the clear liquid. Expose the dried sensitized albumen paper to the vapor of ammonia in a dark box for ten minutes. Wash the prints well in clear running water, then tone in 10 oz. water (distilled) containing gold chloride, 4 grains; acetate of soda, ¼ oz., filtered. Fix in, water, 1 pint; hyposulphite of soda, 8 oz., filtered. Do not use tissue paper.

(2) W. H. S. asks: How can I make acetate of nickel? A. Precipitate an aqueous solution of acetate of nickel with excess of a solution of carbonate of soda, settle, decant the liquid, wash the precipitate, and dissolve it in warm acetic acid. Concentrate by evaporation, and crytallize the salt—acetate of nickel.

(3) A. H. M. writes: 1. Give me a cheap air and water-tight process for making an umbrella air and water proof, which will be as good as a rubber umbrella. A. See p. 368 etc., seq., Spon's Workshop receipts. 2. Can you tell me how to set dyes by the insoluble gelatin process? A. Boil the cloth in weak aqueous solution of glue, then in strong decoction of sumac. 3. Can photographs be burned in on porcelain, glass, or crockeryware? If so, how; or can you mention a book telling anything about it? A. Transfer a well (gold) toned print on a thin gelatin back, to the slightly gummed surface, by wetting the back. Then burn in in the muffle. We know of no book on the subject. 4. What kind of liquid soap is petroleum soluble in oil or partly soluble? A. None that we know of. 5. There is a brilliant leather varnish, I think composed of shellac, gum, camphor, alcohol, and asphaltum. Can you tell me how it is made? A. We do not know the composition of this particular varnish.

(4) H. G. T. asks (1) for information as to what would destroy a little green insect called aphis. They cover the tender buds of a honeysuckle. A. Use a dilute aqueous solution of sulpho-carbonate of potash. Apply with a finely perforated sprinkler. 2. Do you know of anything that will rid the pantry of red ants (very small)? A. Have you tried Dalmatian insect powder, or a strong solution of sugar with three parts borax? 3. Do you know of any party that manufactures or deals in apparatus for pumping by horse power? A. See column of Business and Personal. A small advertisement therein would perhaps procure the desired information.

(5) C. asks for a method of preserving photographs, and also a receipt for renewing photographs that have faded. A. Keep them behind glass and away from the light as much as possible. All ordinary photographs are apt to fade by long exposure to light, and cannot be easily re-developed by chemical means.

(6) O. E. P. writes: In "Notes and Queries," July 24, 1880 (1), "F. J. B." wants to know how to keep pencil drawing, from rubbing out. Having been through the same experience fifteen years ago, I will venture to advise him to use varnish made of bleached shellac and alcohol. Use 95 per cent alcohol and the best shellac to be had; macerate 24 to 36 hours, and strain. Apply with a flat camel's hair brush. Pencil drawings made on manila paper will shrink badly after varnishing, but good drawing paper will come out all right, and if properly varnished may be washed with soap and water when soiled without injury to the lines. Some drawing paper, of an open texture, requires to be sized with a warm aqueous solution of isinglass before varnishing.

(7) F. A. L. writes: In SCIENTIFIC AMERICAN, No. 4, for July 24, "F. J. B." asks for a solution to prevent pencil drawing from rubbing. I think he will find a thin solution of white shellac sprayed on with an atomizer (a 25 cent one is good enough) the easiest method.

(8) J. McM. writes: A distillery near this city, being short of water, desires to lay a five inch iron pipe to a large spring about 3,600 feet distant from the pool they now draw their water from. The standard height of the spring or fountain is 15 feet higher than the top of strainer on the present pipe in the pool. There is a rise from the fountain (about 850 feet from same) of 24 feet, and from there to the pool (about 2,750 feet) a descent of 39 feet from said highest point, making the fall from the fountain as stated, 15 feet from fountain to outlet. The overflow pipe at the pool outlet is 5 feet below the surface of the fountain. Queries: 1. Is it necessary to have a stop valve in the pipe at the fountain? A. No. 2. Is it necessary to have an exhaust pump at the high point? A. Yes. 3. Is it necessary to have a globe valve at the outlet? A. There should be a valve to control the delivery of the water. 4. When filled with water, and the outlet valve opened, will the water continue to run on the siphon principle; and is there any trouble, provided the pipe is air tight, in a successful operation of said pipe on the siphon principle? The ascent from the fountain to the height named is gradual and the descent is gradual. A. Yes, if the pipe is perfectly tight. In laying the pipe we would advise you to sink it in the ground at the highest point as much as possible to reduce the lift.

(9) F. B. asks: At what date was telegraphing practically used in the United States, also in England? A. The first public exhibition of Morse's telegraph in this country was on September 2, 1837. The first working line was built between Washington and Baltimore in 1843–44. On May 27, 1844, the first dispatch was sent. The Morse system was introduced into Europe in 1845.

(10) E. D. T. asks for a recipe for ink powder that will make good black writing ink by dissolving in cold water, so as to be fit for use in a few hours or less. A. Tannic acid, 7 ounces; sulphate of iron (copperas), 1 pound; gum arabic, ½ pound; sugar (white), ¼ pound; powder as finely as possible; rub all together, adding a few drops of clove oil.

(11) F. H. M. asks: How is wood alcohol made? A. It is obtained mixed with pyroligneous acid (crude wood vinegar) from the destructive distillation of wood. When this is heated in a still the first portions distilling are impure wood spirit. This purified by several rectifications (redistillations) yields common wood naphtha. The empyreumatic matters, acetone, etc., which it contains may be removed by heating it in a still over a water bath with an excess of chloride of calcium as long as volatile matters escape (impurities), then distilling the remainder with a quantity of water equal to the spirit taken. Rectification of this dilute spirit over lime yields pure wood naphtha—methylic alcohol.

(12) J. H. M. says: We have had some discussion over the safety of a lightning rod, and would like to have your opinion. The rod is on the spire of one of our churches, about 155 feet from the ground to point of spire. The rod is of ⅜ inch square wrought iron, and without insulation of any kind, but fastened about every 2½ feet by an iron spike driven into the wall or roof. The points are not soldered in any way, but the lower piece is pointed and hooked into an eye in the upper piece. We do not know how the rod is grounded. Do you consider this a safe rod? This spire has been struck once by lightning that we know of. The solder on the cross on top was melted, being the only injury sustained. A. If the rod is thoroughly grounded it may do; but it is not large enough to carry very heavy discharges of electricity, and unless enlarged there is liability to damage. The rod should be ¾ of an inch square, or four times the present size, and all the joints should be thoroughly soldered, so as to make a continuous rod as nearly as possible. If you put on three more rods of the size you have, that would do. The most important part of every rod is the bottom or underground connection. The lower end of the rod should be well connected with a metallic water pipe or gas pipe, or the electrical conducting body having an extensive surface that is in contact with the earth.

(13) D. F. S. writes: I have seen many inquiries about siphons in the column of answers to correspondents. I had some experience with them and find them more difficult things than they are generally supposed to be. The way to get the air out of the neck is to have a cell at the bend on top like an inverted bottle, with a stop cock in the neck. The air will collect in this cell and can be taken out by turning the cock and then filling the cell with water and closing it and again turning the cock. In siphons of large diameter the discharge end must be in water to prevent air from going in. Running water soon fills them with air on account of the small bubbles. A ram is better in such places. The places are not plenty where they are needed, and generally something else would answer better. That is my experience.

(14) C. H. B. asks: Will electricity in transit over or through a wire, or passing along a wire, emit sparks? or will it ignite combustibles that may surround a wire when passing through the same? A. If the wire is used as a lightning conductor, the current is likely to take the nearest ground, and wherever it leaps a space there will be a spark sufficient to ignite combustible substances. An ordinary battery current will not escape from a wire with a spark except when actual contact is made and broken between the terminals of the conductor.

(15) E. S. P.—An analysis of Smith Bros.' borax (slightly effloresced) gave: anhydrous borax, 53·01 per cent; water, 46·24 per cent; chlorides, 0·71. A sample of fine English borax (also slightly effloresced) gave: anhydrous borax, 58·63 per cent; water, 41·15 per cent; chlorides, 0·22 per cent.

(16) C. N. M. writes: In an argument, I contended that, in looking at the moon through a telescope first, and then through an empty tube of same dimensions—although illusory—it seemed really to the eye, to take a longer time for the moon to pass from sight while looking through the empty tube, than it did the telescope. The other party held out that there was no apparent difference in either. I tried to explain that the difference was caused in being magnified and bringing the object nearer to the eye. Which is right? A. You are right. The apparent motion of the moon is magnified in the same proportion as its disk is magnified, so that with the lenses in the telescope tube, the moon would pass much more rapidly out of the field than with the empty tube.

(17) G. J. S. writes: Thinking it an advantage to have the water consumed by our boilers by register rather than by yearly rent, we would like to find out the amount used at present, and would, therefore, respectfully ask you to inform me how many gallons of water will be consumed per hour per horse power at 75 lb. steam pressure? A. If your boiler and engine are reasonably good and properly run, you will require between 3 and 3½ gallons of water per hour per horse power.

(18) F. W. S. asks: 1. Can an engine with a cylinder say 2 inches diameter and 4 inches stroke, be constructed upon the principle of the small oscillating toy engines that would be of any utility for driving machinery? A. Yes, to work one-half to three-fourths horse power. 2. What should be the boiler capacity for size above given? A. Should have 10 to 12 feet face surface.

(19) E. A. B. asks (1) how outriggers are made for raceboats? A. Outriggers are generally made of iron ⅜ inch to ⅝ inch diameter, with the offset required and bolted to side of boat. 2. Is a boat 16 feet in length and 2 feet beam large enough for two oarsmen? A. 2 feet beam is not sufficient, it should be at least 3 feet.

COMMUNICATIONS RECEIVED.

On the Hydraulic Mineral Belt of Texas. By J. D.

On Mechanical Measures for Affecting the Water. By G. H. B.

Not a Serpent. By J. A. C.

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[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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Beveling edges of plates, apparatus for, R. Riggs, Philadelphia, Pa.
Brick machine, W. L. Gregg, Philadelphia, Pa.
Churn, rotary, S. W. Murch *et al.*, Kennedy, N. Y.
Flour purifying apparatus, D. B. Mosely, Hartford, Conn.
Garments, A. Horner, Baltimore, Md.
Gas apparatus, E. Stern, New York city.
Governor, engine, G. F. Pottle, Boston, Mass.
Harvesting machine, D. House, Lathrop, Cal.
Ink bottle, E. W. Stiles, Hartford, Conn.
Labels, express, etc., J. H. Small, Buffalo, N. Y.
Pens, fountain, A. T. Cross, Providence, R. I.
Phosphoric acid, apparatus for pulverizing, E. N. Horsford, Cambridge, Mass.
Pictures, transferring, H. K. Flagler, Boston, Mass.
Printing machinery, W. P. Kidder, Boston, Mass.
Railroad signal, J. A. Emery *et al.*, Boston, Mass.
Railroad signal, J. L. Williams, Riverton, N. J.
Refrigerating apparatus, J. Chase, Boston, Mass.
Screw threads, machine for cutting, I. S. Schuyler *et al.*, Brooklyn, N. Y.
Signaling apparatus for mines, C. Cummings, Virginia City, Nev.
Type, means for holding curved lines, of, H. P. Hubbard, New Haven, Conn.
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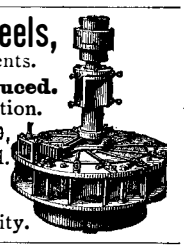

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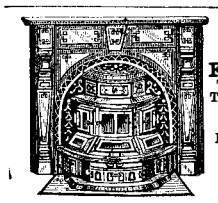

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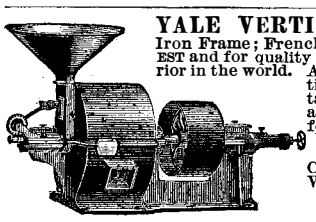

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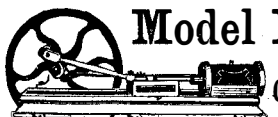

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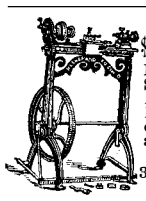

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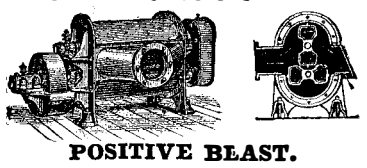

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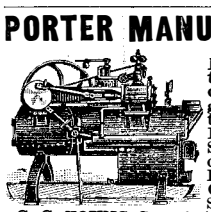

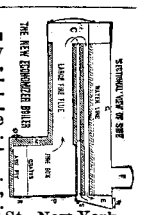

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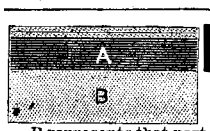

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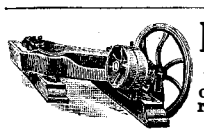

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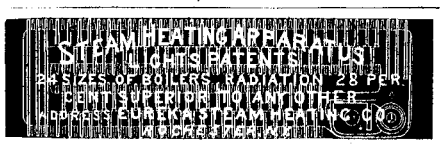

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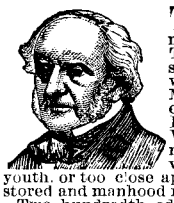

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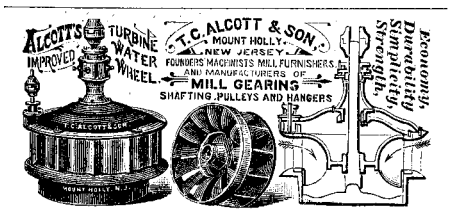
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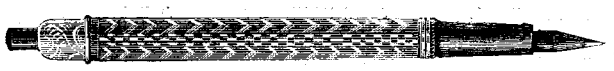

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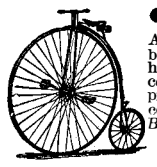

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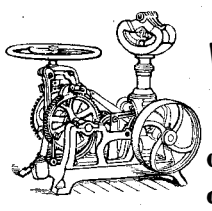

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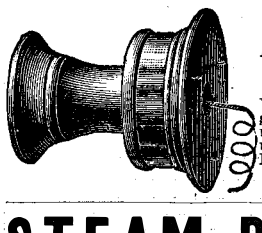

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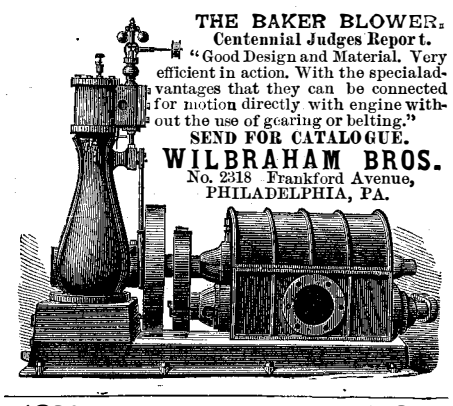

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